US ERA ARCHIVE DOCUMENT

# ATTACHMENT E: POST-INJECTION SITE CARE (PISC) AND SITE CLOSURE PLAN

# **Facility Information**

**Facility Name:** FutureGen 2.0 Morgan County CO<sub>2</sub> Storage Site

IL-137-6A-0004 (Well #4)

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Location of Injection Well: Morgan County, IL; 26–16N–9W; 39.800266°N and 90.07469°W

This Post-Injection Site Care and Site Closure (PISC) plan describes the activities that the FutureGen Alliance will perform to meet the requirements of 40 CFR 146.93. The FutureGen Alliance will monitor ground water quality and track the position of the carbon dioxide plume and pressure front for fifty years of post-injection site care and may not cease post-injection monitoring and site care until a demonstration of non-endangerment of USDWs has been approved by the UIC Program Director pursuant to 40 CFR 146.93(b)(3). Following approval for site closure, the FutureGen Alliance will plug all monitoring wells, restore the site to its original condition, and submit a Site Closure report and associated documentation.

# **Pre- and Post-Injection Pressure Differential**

The information regarding pre- and post-injection pressure differentials, as required by 40 CFR 146.93(a)(2)(i) is presented below.

The maximum injection pressure differential is 479 psi at the injection well when injection stops. The magnitude and area of elevated pressure gradually decreases over time after injection stops; as further detailed in Table 1.

Figure 1 shows the pressure differential versus time for monitoring well locations in the Area of Review (AoR) and at the geometric centroid of the four horizontal injection wells. Simulated pressures at the injection "point" increase during the 20-year injection period from 1,779 psi to a maximum of 2,258 psi. The highest pressures are in the immediate vicinity of each injection well. As shown, pressures at the injection and monitoring well locations decline over time after injection ceases. Despite the modeled pressure of 2,258 psi, current permit limitations will require the pressure in the injection well not to exceed 2,252 psi.

Figure 2 presents aqueous pressure differentials from baseline at the top of the injection zone and the extent of the carbon dioxide plume at 20 years after the start of injection (i.e., the end of injection) and 70 years after the start of injection (i.e., at site closure).

Table 1. Pressure differential to baseline conditions at well locations near the base of the Ironton Formation for Above Confining Zone Well 1 (ACZ1) and ACZ2 and at the middle of the Mount Simon 11 layer in the injection zone for the rest of the wells during and after.

Pressure Differential (psi)					
Year	SLR1	SLR2	ACZ1	ACZ2	Injection Well
Distance from Injection Well (ft)	3740	6555	1010	3740	0
Elevation (ft)	-3371	-3414	-2763	-2751	-3390
0 (Start injection)	0	0	0	0	0
1	223	125	0	0	350
2	277	165	0	0	394
3	311	192	0	0	417
4	333	211	0	0	431
5	348	225	0	0	441
10	393	274	0	0	466
15	413	313	1	1	475
20 (Stop injection at year end)	425	338	2	2	479
21	255	235	2	2	259
22 (Approximate maximum extent of CO <sub>2</sub>					
Plume)	199	186	2	2	200
23	167	157	2	2	167
24	145	137	3	3	145
25	129	121	3	3	128
30	85	81	4	4	84
35	64	61	4	4	63
40	51	49	5	5	50
45	42	40	5	5	41
50	36	34	5	5	35
60	27	26	5	5	26
70	22	21	5	5	21
80	18	17	5	5	17
90	15	14	5	5	14
100	13	12	4	4	12
SLR1 Single-Level in-Reservoir #1					
SLR2	2 Single-	Level in-	-Reservoi	r #2	
ACZ	Above	Confinin	g Zone#	1	
ACZ	2 Above	Confinin	g Zone#	2	
Injection Well Geometric centroid of four horizontal laterals			tal laterals		

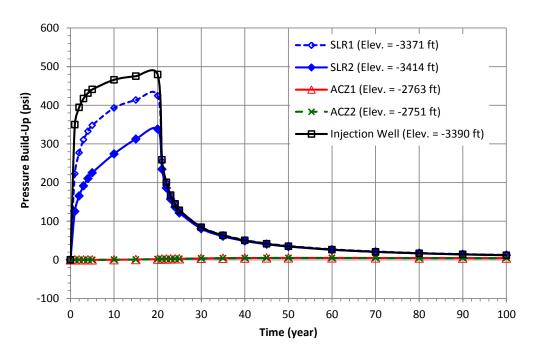


Figure 1. Simulated aqueous pressure differential versus time at monitoring well locations near the base of the Ironton Formation for ACZ1 and ACZ2 and at the middle of the Mount Simon 11 layer in the injection zone for the rest of the wells.

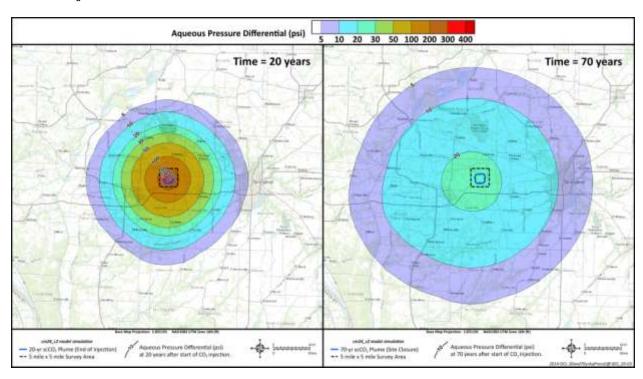


Figure 2. Aqueous pressure differentials from baseline condition at the top of the injection zone and  $CO_2$  plume extents at 20 years (end of injection) and 70 years (site closure) after start of injection.

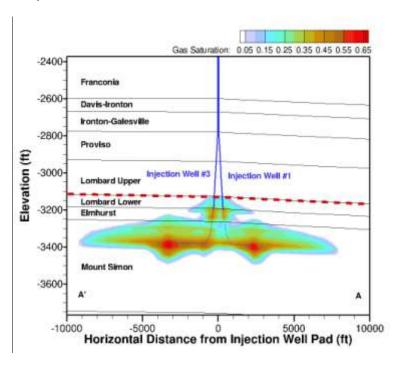
# <u>Predicted Position of the CO<sub>2</sub> Plume and Associated Pressure Front Upon Cessation of Injection and at Site Closure</u>

The information regarding the predicted position of the carbon dioxide plume and associated pressure front at site closure, as required by 40 CFR 146.93(a)(2)(ii) is presented below.

The areal extent of the  $CO_2$  plume increases during injection and for 2 years post-injection. As the areal extent decreases (at year 22), the plume migrates predominately upward. The computational modeling results indicate that the sequestered  $CO_2$  will migrate above the Mount Simon Sandstone, into the Elmhurst as well as the lower part of the Lombard.

Figure 3 and Figure 4 show the upward migration of the CO<sub>2</sub> plume near the injection wells at 20 and 70 years. These two-dimensional images demonstrate various levels of gas saturation or upward migration into the injection zone (Mount Simon Formation, Elmhurst Sandstone, and the lower part of the Lombard). The computational model results indicate that the Model Layer "Lombard 5" is the top unit containing a fraction of injected CO<sub>2</sub> during the 100-year simulation. The top of the injection zone is set at 3,153 ft (below MSL) at the FutureGen stratigraphic well, corresponding to the top of the Lombard 5 layer of the numerical model.

The computational model estimates that the  $CO_2$  plume forms a cloverleaf pattern as a result of the four lateral-injection-well design. The plume grows both laterally and vertically as injection continues. Most of the  $CO_2$  resides in the Mount Simon Sandstone. A small amount of  $CO_2$  enters into the Elmhurst and the lower part of the Lombard Formation. When injection ceases at 20 years, the lateral growth becomes negligible but the plume continues to move slowly primarily upward. Once  $CO_2$  reaches the low-permeability zone in the upper Mount Simon it begins to move laterally.



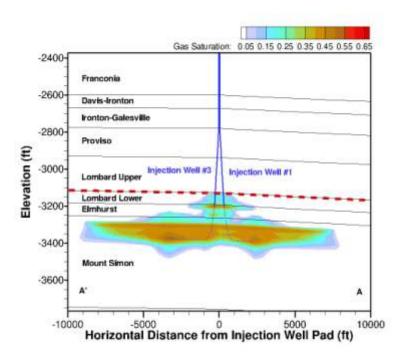


Figure 3. Cutaway view of CO<sub>2</sub>-rich phase saturation along A-A' (Injection Wells 1 and 3) at 20 and 70 years. The red dashed line indicates the top of the injection zone.

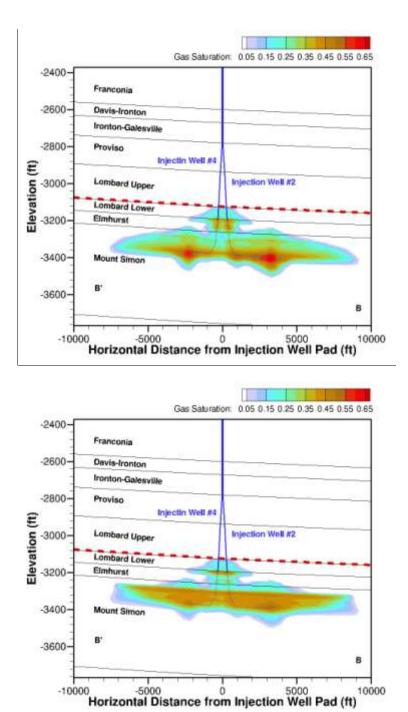


Figure 4. Cutaway view of  $CO_2$ -rich phase saturation along B-B' (Injection Wells 2 and 4) at 20 and 70 years. The red dashed line indicates the top of the injection zone.

Reservoir conditions are such that the  $CO_2$  remains in the supercritical state throughout the domain and for the entire simulation period. The three-dimensional distribution of the  $CO_2$ -rich (or separate-) phase saturation is presented for selected times (i.e., 20 and 70 years). Additionally, to better illustrate the  $CO_2$  migration through time and space, a cross-sectional view of the  $CO_2$  plume is presented as slices through the center of the injection wells and along

the well traces. Figure 3 and Figure 4 show the CO<sub>2</sub>-rich (or separate) phase saturation for selected times for slices A-A' and B-B', respectively.

The maximum pressure differential corresponds to the end of the injection period (year 20). After that time, the pressure slowly dissipates, resulting in the maximum pressure differential being below 30 psi at 70 years, and below 20 psi at 100 years. The pressure differential distribution has been presented instead of a defined pressure front because the calculated pressure head in the Mt. Simon is greater than the calculated pressure head in the lowermost underground source of drinking water (USDW), the St. Peter Sandstone, under initial conditions prior to injection. Figure 2 presents aqueous pressure differentials from baseline at the top of the injection zone and the extent of the carbon dioxide plume at 20 years after the start of injection (i.e., at site closure).

The model predicts that the areal extent of the  $CO_2$  plume (defined as 99.0 percent of the separate-phase  $CO_2$  mass) increases during injection and for 2 years post-injection and then begins to decrease as buoyancy forces dominate and plume migration is predominately upward. Figure 5 shows the cumulative area of the  $CO_2$  mass plume with time. The maximum plume extent, 6.46 mi<sup>2</sup>, occurs at 22 years after the start of injection (2 years after the cessation of injection).

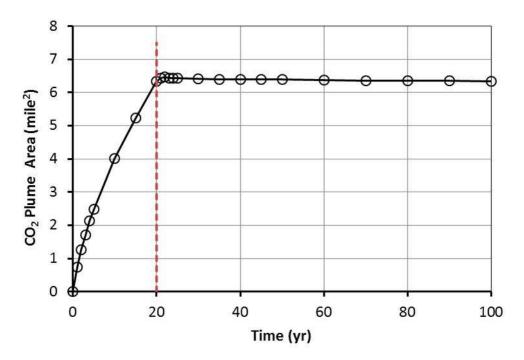


Figure 5. Simulated plume area over time (the vertical dashed line denotes the time CO<sub>2</sub> injection ceases).

The predicted extent of the  $CO_2$  plume at the time of site closure, 50 years after the cessation of  $CO_2$  injection, was determined from the computational model results.

Figure 6 shows the predicted areal extent of the  $CO_2$  plume (defined as 99.0 percent of the separate-phase  $CO_2$  mass) at the time of site closure. The simulation predictions show that 99.0 percent of the separate-phase  $CO_2$  mass would be contained within an area of 6.35 mi<sup>2</sup> at the

time of site closure. This plume is only 1.7% smaller than the maximum plume area, which occurs at 22 years after the start of injection (Figure 5).

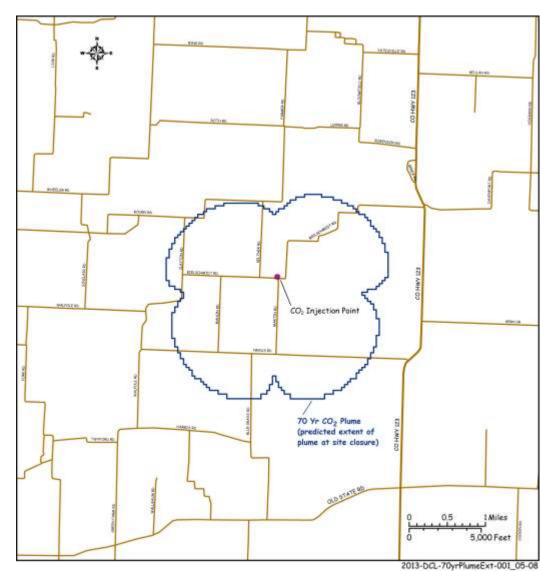


Figure 6. Simulated areal extent of the  $CO_2$  plume at the time of site closure (70 years after  $CO_2$  injection was initiated).

# **Post-Injection Monitoring Plan**

FutureGen will perform post-injection monitoring, as required by 40 CFR 146.93(b), as described below.

Pressure monitoring of the injection zone will occur in four monitoring wells. The Testing and Monitoring Plan (Attachment C of this permit) describes the planned monitoring activities. In addition, FutureGen will conduct groundwater sampling in the shallow, semi-consolidated glacial sediments that make up the surficial aquifer.

## Quality assurance and surveillance measures:

Data quality assurance and surveillance protocols adopted by the project are designed to facilitate compliance with the requirements specified in 40 CFR 146.90(k). Quality Assurance (QA) requirements for direct measurements within the injection zone, above the confining zone, and within the shallow USDW aquifer that are critical to the post-injection monitoring, program (e.g., pressure and aqueous concentration measurements) are described in the Quality Assurance and Surveillance Plan (QASP) that is presented in Appendix G of the Testing and Monitoring Plan. These measurements will be performed based on best industry practices and the QA protocols recommended by the geophysical services contractors selected to perform the work.

# Location of Monitoring Wells

Monitoring well locations are described in the Testing and Monitoring Plan (Attachment C of this permit). Their coordinates are provided in Appendix A of this plan. The objective of the monitoring program is to select and implement a suite of monitoring technologies that are both technically robust and provide an effective means of 1) evaluating CO<sub>2</sub> mass balance, 2) detecting any unforeseen containment loss, and 3) evaluating pressure changes in the reservoir to ensure that monitored values corroborate modeled expectations.

As part of the project's design optimization, the monitoring well network has been configured (Figure 7) to effectively monitor and account for the injected CO<sub>2</sub> and pressure changes. The design includes a total of nine monitoring wells:

- Two Above Confining Zone (ACZ) wells. These wells will be used to monitor immediately above the Eau Claire caprock in the Ironton Sandstone. Monitored parameters include: pressure, temperature, and hydrogeochemical indicators of CO<sub>2</sub> (Table 6).
- Two Single-Level in-Reservoir (SLR) wells (one of which is a reconfiguration of the previously drilled stratigraphic well). These wells will be used to monitor within the injection zone beyond the east and west ends of the horizontal CO<sub>2</sub>-injection laterals. Monitored parameters include: pressure, temperature, and hydrogeochemical indicators of CO<sub>2</sub> (Table 6). One additional SLR well (a tenth monitoring well) will be installed outside of the expected CO<sub>2</sub> plume to monitor pressure effects in the injection zone.
- Three Reservoir Access Tubes (RAT) wells. These are fully cased wells, which allow access for monitoring instrumentation in the reservoir via pulsed neutron capture (PNC)

logging equipment. To avoid two-phase flow near the borehole, which can distort the  $CO_2$  saturation measurements, the wells will not be perforated. Monitoring parameters include: quantification of  $CO_2$  saturation across the reservoir and caprock.

• One USDW well. This well will be used to monitor the lowermost USDW (the St. Peter Sandstone). Monitored parameters include: pressure, temperature, and hydrogeochemical indicators of CO<sub>2</sub> (Table 6).

FutureGen will also conduct sampling in the shallow, semi-consolidated glacial sediments that make up the surficial aquifer, using 9 local landowner wells and one well drilled for the project, to establish baseline conditions. The coordinates of these wells are provided in Appendix B of this plan.

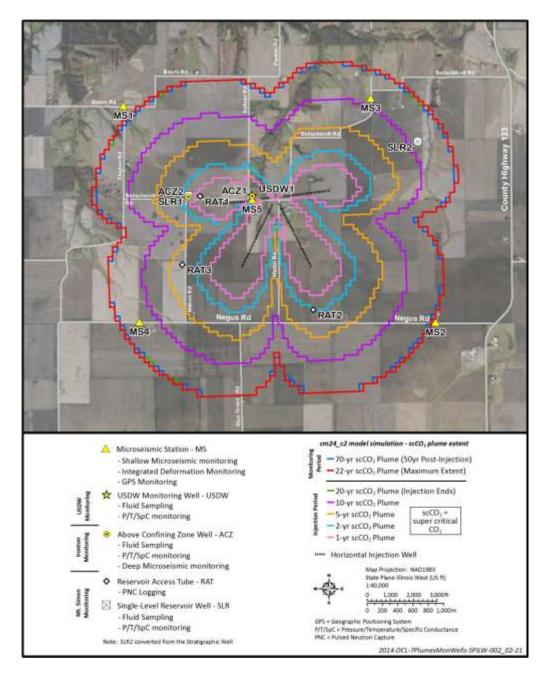


Figure 7. Map of monitoring well locations.

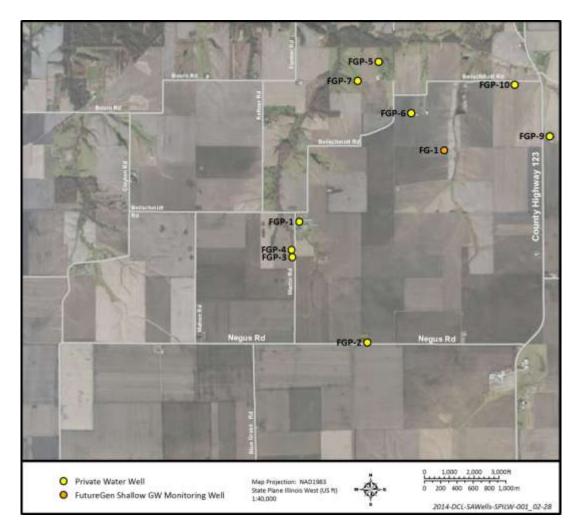


Figure 8. Surficial aquifer monitoring locations. Well FG-1 is a dedicated well drilled for the purposes of the FutureGen project, while wells FGP-1 through FGP-10 wells are local landowner wells.

# Summary of Planned Post-Injection Monitoring Activities

The suite of indirect geophysical monitoring methods that will be used to monitor the areal extent, evolution, and fate and transport of the injected CO<sub>2</sub> plume during PISC include: PNC logging, passive seismic monitoring, integrated surface deformation monitoring, and time-lapse gravity surveys. Table 2 summarizes the testing and monitoring activities planned for the post-injection phase; collection and recording of continuous monitoring data will occur at the frequencies described in Table 13.

Table 2. Summary of post-injection monitoring activities.

Monitoring Category	Monitoring Method/Location	Frequency (Post-Injection Phase)
	Fluid sampling in surficial aquifers: 10 local landowner wells and 1 project-drilled well	None Planned
		Geochemistry Every 5 years
Groundwater Quality and Geochemistry Monitoring	Fluid sampling in St. Peter: one lowermost USDW well	Continuous temperature and pressure monitoring
		Geochemistry Every 5 years
	Fluid sampling in Ironton: two ACZ wells	Continuous temperature and pressure monitoring
	Fluid sampling in Mount Simon: SLR monitoring wells	Every 5 years
Injection Zone Monitoring	Pulsed-neutron capture (PNC) logging at 3 RAT wells	Every 5 years
	Pressure monitoring in Mount Simon: two SLR monitoring wells	Continuous
	Integrated deformation monitoring: five surface monitoring stations	Continuous
Indirect Geophysical Monitoring Techniques	Passive deep microseismic arrays in two ACZ wells and five seismometers in shallow cased bore holes.	Continuous
Note: For details and information	ation on continuous monitoring, see Table 13.	

# **Groundwater Quality Monitoring**

FutureGen will conduct groundwater sampling every 5 years according to the procedures described below.

Specific information concerning the sampling methods, analytical techniques, laboratories and quality assurance for sampling for the post-injection monitoring program are presented in the FutureGen QASP; see Table A.2 for Monitoring Tasks, Methods, and Schedule.

Sampling will take place at the frequencies specified in Table 3 (for the surficial aquifers), Table 4 (for the St. Peter), and Table 5 (for the Ironton). Because near-surface environmental impacts are not expected, surficial aquifer (<100 ft bgs) monitoring will only be conducted for a sufficient duration to establish baseline conditions (minimum of three sampling events) during the injection phase of the project.

- Surficial aquifer monitoring is not planned during the post-injection phase; however, the
  need for additional surficial aquifer monitoring will be continually evaluated throughout
  the operational phases of the project, and may be reinstituted if conditions warrant or if
  requested by the EPA UIC Program Director.
- Target parameters for the ACZ wells include pressure, temperature, hydrogeochemical indicators of CO<sub>2</sub> (Table 6), and brine composition.
- Target parameters for the USDW and surficial aquifer wells include pressure, temperature, hydrogeochemical indicators of CO<sub>2</sub> (Table 6), and brine composition.

If a leakage response is observed in the ACZ early-detection monitoring wells (Ironton) then the decision not to institute USDW aquifer triggers will be reevaluated based on the magnitude of the observed leakage response and predictive simulations of CO<sub>2</sub> transport between the Ironton and the St. Peter Formations.

Table 3. Sampling schedule for surficial aquifer monitoring wells.

Monitoring well name/location/map reference: Surficial aquifer monitoring wells Well depth/formation(s) sampled: Shallow glacial sediments (approx. 17 ft – 49 ft)			
Parameter/Analyte	Frequency (Post-Injection Phase)		
Dissolved or separate-phase CO <sub>2</sub>	None Planned		
Pressure	None Planned		
Temperature	None Planned		
Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic carbon, total organic carbon, carbon and water isotopes, and radon	None Planned		

Table 4. Sampling schedule for the USDW monitoring well.

Monitoring well name/location/map reference: One USDW monitoring well (see Figure 7)  Well depth/formation(s) sampled: St. Peter Sandstone (2,000 ft)  Frequency				
Parameter/Analyte	(Post-Injection Phase)			
Dissolved or separate-phase CO <sub>2</sub>	Every 5 years			
Pressure	Continuous			
Temperature	Continuous			
Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic carbon, total organic carbon, carbon and water isotopes, and radon	Every 5 years			
Note: For details and information on continuous monitoring, see Table 13.				

Table 5. Sampling schedule for ACZ monitoring wells.

Monitoring well name/location/map reference: Two ACZ monitoring wells (see Figure 7) Well depth/formation(s) sampled: Ironton Sandstone (3,470 ft)			
Parameter/Analyte	Frequency (Post-Injection Phase)		
Dissolved or separate-phase CO <sub>2</sub>	Every 5 years		
Pressure	Continuous		
Temperature	Continuous		
Other parameters, including total dissolved solids, pH, specific conductivity, major cations and anions, trace metals, dissolved inorganic carbon, total organic carbon, carbon and water isotopes, and radon	Every 5 years		
Note: For details and information on continuous monitoring, see Table 13.			

Note: collection and recording of continuous monitoring data will occur at the frequencies described in Table 13.

#### Sampling methods:

Sampling procedures are discussed below, and specific details are provided in the FutureGen QASP Table A.2.

During all groundwater sampling, field parameters (pH, specific conductance, and temperature) will be monitored for stability and used as an indicator of adequate well purging (i.e., parameter stabilization provides indication that a representative sample has been obtained). Calibration of field probes will follow the manufacturer's instructions using standard calibration solutions. A comprehensive list of target analytes and groundwater sample collection requirements is provided in Table 6. All analyses will be performed in accordance with the analytical requirements listed in Table 7. Additional analytes may be included for the shallow USDW based on landowner requests (e.g., coliform bacteria).

Sampling and analytical techniques for target parameters are given in Table 6 and Table 7, respectively.

Table 6. Aqueous sampling requirements for target parameters.

Parameter	Volume/Container	Preservation	Holding Time
Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si,	20-mL plastic vial	Filtered (0.45 μm), HNO <sub>3</sub> to pH <2	60 days
Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl	20-mL plastic vial	Filtered (0.45 μm), HNO <sub>3</sub> to pH <2	60 days
Cyanide (CN-)	250-mL plastic vial	NaOH to pH > 12, 0.6g ascorbic acid Cool 4°C,	14 days
Mercury	250-mL plastic vial	Filtered (0.45 μm), HNO <sub>3</sub> to pH <2	28 days
Anions: Cl <sup>-</sup> , Br <sup>-</sup> , F <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup>	125-mL plastic vial	Filtered (0.45 μm), Cool 4°C	45 days
Total and Bicarbonate Alkalinity (as CaCO <sub>3</sub> <sup>2</sup> )	100-mL HDPE	Filtered (0.45 μm), Cool 4°C	14 days
Gravimetric Total Dissolved Solids (TDS)	250-mL plastic vial	Filtered (0.45 μm), no preservation, Cool 4°C	7 days
Water Density	100-mL plastic vial	No preservation, Cool 4°C	
Total Inorganic Carbon (TIC)	250-mL plastic vial	H <sub>2</sub> SO <sub>4</sub> to pH <2, Cool 4°C	28 days
Dissolved Inorganic Carbon (DIC)	250-mL plastic vial	Filtered (0.45 $\mu$ m), $H_2SO_4$ to $pH$ <2, Cool 4°C	28 days
Total Organic Carbon (TOC)	250-mL amber glass	Unfiltered, H <sub>2</sub> SO <sub>4</sub> to pH <2, Cool 4°C	28 days
Dissolved Organic Carbon (DOC)	125-mL plastic vial	Filtered (0.45 $\mu$ m), $H_2SO_4$ to $pH$ <2, Cool 4°C	28 days
Volatile Organic Analysis (VOA)	Bottle set 1: 3-40-mL sterile clear glass vials Bottle set 2: 3-40-mL sterile amber glass vials	Zero headspace, Cool <6 °C, Clear glass vials will be UV-irradiated for additional sterilization	7 days
Methane	Bottle set 1: 3-40-mL sterile clear glass vials Bottle set 2: 3-40-mL sterile amber glass vials	Zero headspace, Cool <6 °C, Clear glass vials (bottle set 1) will be UV- irradiated for additional sterilization	7 days
Stable Carbon Isotopes $^{13/12}$ C $(\delta^{13}$ C) of DIC in Water	60-mL plastic or glass	Filtered (0.45-μm), Cool 4°C	14 days
Radiocarbon <sup>14</sup> C of DIC in Water	60-mL plastic or glass	Filtered (0.45-μm), Cool 4°C	14 days
Hydrogen and Oxygen Isotopes $^{2/1}$ H ( $\delta$ D) and $^{18/16}$ O ( $\delta$ <sup>18</sup> O) of Water	60-mL plastic or glass	Filtered (0.45-μm), Cool 4°C	45 days

Parameter	Volume/Container	Preservation	Holding Time		
Carbon and Hydrogen Isotopes ( <sup>14</sup> C, <sup>13/12</sup> C, <sup>2/1</sup> H) of Dissolved Methane in Water	1-L dissolved gas bottle or flask	Benzalkonium chloride capsule, Cool 4°C	90 days		
Compositional Analysis of Dissolved Gas in Water (including N <sub>2</sub> , CO <sub>2</sub> , O <sub>2</sub> , Ar, H <sub>2</sub> , He, CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub> , iC <sub>4</sub> H <sub>10</sub> , nC <sub>4</sub> H <sub>10</sub> , iC <sub>5</sub> H <sub>12</sub> , nC <sub>5</sub> H <sub>12</sub> , and C <sub>6</sub> +)	1-L dissolved gas bottle or flask	Benzalkonium chloride capsule, Cool 4°C	90 days		
Radon ( <sup>222</sup> Rn)	1.25-L PETE	Pre-concentrate into 20-mL scintillation cocktail. Maintain groundwater temperature prior to pre-concentration	1 day		
рН	Field parameter	None	<1 h		
Specific Conductance	Field parameter	None	<1 h		
HDPE = high-density polyethylene; PETE = polyethylene terephthalate					

Table 7. Analytical requirements.

Table 7. Analytical requirements.				
Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si,	ICP-AES, EPA Method 6010B or similar	1 to 80 µg/L (analyte dependent)	±10%	Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20
Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl	ICP-MS, EPA Method 6020 or similar	0.1 to 2 µg/L (analyte dependent)	±10%	Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20
Cyanide (CN-)	SW846 9012A/B	5 μg/L	±10%	Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20
Mercury	CVAA SW846 7470A	0.2 μg/L	±20%	Daily calibration; blanks, LCS, and duplicates and matrix spikes at 10% level per batch of 20
Anions: Cl¯, Br¯, F¯, SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> ¯	Ion Chromatography, EPA Method 300.0A or similar	33 to 133 μg/L (analyte dependent)	±10%	Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20
Total and Bicarbonate Alkalinity (as CaCO <sub>3</sub> <sup>2-</sup> )	Titration, Standard Methods 2320B	1 mg/L	±10%	Daily calibration; blanks, LCS, and duplicates at 10% level per batch of 20
Gravimetric Total Dissolved Solids (TDS	Gravimetric Method Standard Methods 2540C	10 mg/L	±10%	Balance calibration, duplicate samples
Water Density	ASTM D5057	0.01 g/mL	±10%	Balance calibration, duplicate samples
Total Inorganic Carbon (TIC)	SW846 9060A or equivalent Carbon analyzer, phosphoric acid digestion of TIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Dissolved Inorganic Carbon (DIC)	SW846 9060A or equivalent Carbon analyzer, phosphoric acid digestion of DIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Total Organic Carbon (TOC)	SW846 9060A or equivalent Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector.	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Dissolved Organic Carbon (DOC)	SW846 9060A or equivalent Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector.	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Volatile Organic Analysis (VOA)	SW846 8260B or equivalent Purge and Trap GC/MS	0.3 to 15 µg/L	±20%	Blanks, LCS, spike, spike duplicates per batch of 20
Methane	RSK 175 Mod Headspace GC/FID	10 μg/L	±20%	Blanks, LCS, spike, spike duplicates per batch of 20
Stable Carbon Isotopes <sup>13/12</sup> C (1 <sup>13</sup> C) of DIC in Water	Gas Bench for <sup>13/12</sup> C	50 ppm of DIC	±0.2p	Duplicates and working standards at 10%

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Radiocarbon <sup>14</sup> C of DIC in Water	AMS for <sup>14</sup> C	Range: 0 i 200 pMC	±0.5 pMC	Duplicates and working standards at 10%
Hydrogen and Oxygen Isotopes $^{2/1}$ H ( $\delta$ ) and $^{18/16}$ O ( $1^{18}$ O) of Water	CRDS H <sub>2</sub> O Laser	Range: - 500% to 200% vs. VSMOW	<sup>2/1</sup> H: ±2.0‰ <sup>18/16</sup> O: ±0.3‰	Duplicates and working standards at 10%
Carbon and Hydrogen Isotopes ( <sup>14</sup> C, <sup>13/12</sup> C, <sup>2/1</sup> H) of Dissolved Methane in Water	Offline Prep & Dual Inlet IRMS for <sup>13</sup> C; AMS for <sup>14</sup> C	<sup>14</sup> C Range: 0 & DupMC	<sup>14</sup> C: ±0.5pMC <sup>13</sup> C: ±0.2‰ <sup>2/1</sup> H: ±4.0‰	Duplicates and working standards at 10%
Compositional Analysis of Dissolved Gas in Water (including $N_2$ , $CO_2$ , $O_2$ , $Ar$ , $H_2$ , $He$ , $CH_4$ , $C_2H_6$ , $C_3H_8$ , $iC_4H_{10}$ , $nC_4H_{10}$ , $iC_5H_{12}$ , $nC_5H_{12}$ , and $C_6+$ )	Modified ASTM 1945D	1 to 100 ppm (analyte dependent)	Varies by compon-ent	Duplicates and working standards at 10%
Radon ( <sup>222</sup> Rn)	Liquid scintillation after pre- concentration	5 mBq/L	±10%	Triplicate analyses
pН	pH electrode	2 to 12 pH units	±0.2 pH unit For indication only	User calibrate, follow manufacturer recommendations
Specific Conductance	Electrode	0 to 100 mS/cm	±1% of reading For indication only	User calibrate, follow manufacturer recommendations

 $ICP-AES = inductively \ coupled \ plasma \ atomic \ emission \ spectrometry; \ ICP-MS = inductively \ coupled \ plasma \ mass \ spectrometry; \ LCS = laboratory \ control \ sample; \ GC/MS = gas \ chromatography-mass \ spectrometry; \ GC/FID = gas \ chromatography \ with \ flame \ ionization \ detector; \ AMS = accelerator \ mass \ spectrometry; \ CRDS = cavity \ ring \ down \ spectrometry; \ IRMS = isotope \ ratio \ mass \ spectrometry; \ LC-MS = liquid \ chromatography-mass \ spectrometry; \ ECD = electron \ capture \ detector$ 

# Laboratory to be used/chain-of-custody procedures:

Samples will be tracked using appropriately formatted chain-of-custody forms. The sample handling and chain of custody of water, formation fluids, and pipeline fluid as well as environmental gas or air samples will conform to EPA guidance, and be conducted as discussed in Sections B.1.3 and B.1.5 thru B.1.7 of the FutureGen QASP (Appendix G of the Testing and Monitoring Plan).

# Plan for guaranteeing access to all monitoring locations:

The land on which the ACZ and USDW wells are located will either be purchased or leased for the life of the project, so access will be secured.

Access to the surficial aquifer wells will not be required over the lifetime of the project. Access to wells for baseline sampling has been on a voluntary basis by the well owner. Nine local landowners agreed to have their surficial aquifer wells sampled although sampling is not anticipated in surficial wells during the PISC period.

# Carbon Dioxide Plume and Pressure-Front Tracking

# **Direct Pressure Monitoring:**

FutureGen will conduct direct pressure-front monitoring to meet the requirements of 40 CFR 146.93(b). Continuous monitoring of injection zone pressure and temperature (P/T) will be performed with sensors installed in wells that are completed in the injection zone. P/T monitoring in the monitoring wells will be performed using a real-time monitoring system with surface readout capabilities so that pressure gauges do not have to be removed from the well to retrieve data.

The following measures will be taken to ensure that the pressure gauges are providing accurate information on an ongoing basis:

- High-quality (high-accuracy, high-resolution) gauges with low drift characteristics will be used.
- Gauge components (gauge, cable head, cable) will be manufactured of materials designed to provide a long life expectancy for the anticipated downhole conditions.
- Upon acquisition, a calibration certificate will be obtained for every pressure gauge. The calibration certificate will provide the manufacturer's specifications for range, accuracy (% full scale), resolution (% full scale), drift (< psi per year), and calibration results for each parameter. The calibration certificate will also provide the date that the gauge was calibrated and the methods and standards used.
- Gauges will be installed above any packers so they can be removed if necessary for recalibration by removing the tubing string. Redundant gauges may be run on the same cable to provide confirmation of downhole pressure and temperature. Pressure gauges will be calibrated on an annual basis with current annual calibration certificates provided with test results to the EPA. In lieu of removing the injection tubing, the calibration of downhole pressure gauges will demonstrate accuracy by using a second pressure gauge, with current certified calibration, that will be lowered into the well to the same depth as the permanent downhole gauge. Calibration curves, based on annual calibration checks (using the second calibrated pressure gauge) developed for the downhole gauge, can be used for the purpose of the fall-off test. If used, these calibration curves (showing all historic pressure deviations) will accompany the fall-off test data submitted to the EPA.

- Upon installation, all gauges will be tested to verify they are functioning (reading/transmitting) correctly.
- Gauges will be pulled and recalibrated whenever a workover occurs that involves removal of tubing. A new calibration certificate will be obtained whenever a gauge is recalibrated.

Direct pressure monitoring in the injection zone will take place as indicated in Table 8. Collection and recording of continuous monitoring data will occur at the frequencies described in Table 13.

Table 8. Monitoring schedule for direct pressure-front tracking.

Well Location/Map Reference	Depth(s)/Formation(s)	Frequency (Post-Injection Phase)		
Two SLR monitoring wells (SLR Wells 1 and 2, see Figure 7)	Mount Simon/4,150 ft.	Continuous		
Note: For details and information on continuous monitoring, see Table 13.				

## **Direct Geochemical Plume Monitoring:**

FutureGen will conduct direct CO<sub>2</sub> plume monitoring to meet the requirements of 40 CFR 146.93(b). Target parameters include pressure, temperature, and hydrogeochemical indicators of CO<sub>2</sub> (Table 6) and brine composition.

In addition to direct plume sampling and characterization, indirect montoring of the CO<sub>2</sub> plume will be conducted by continuing the periodic PNC logging across the injection zone and primary confining zone. PNC logging is a proven method for quantifying CO<sub>2</sub> saturation around a borehole. The PNC logging will be conducted using the three RAT wells. The RAT wells will be logged every 5 years during the post-injection period. Information collected will be compared with prior logs to determine trends.

Direct fluid sampling in the injection zone will take place as indicated in

Table 9 (collection and recording of continuous monitoring data will occur at the frequencies described in Table 13).

Table 9. Monitoring schedule for direct geochemical plume monitoring.

Monitoring well name/location/map reference: Two SLR monitoring wells (see Figure 7) Well depth/formation(s) sampled: Mount Simon Sandstone (4,150 ft)		
Parameter/Analyte	Frequency (Post-Injection Phase)	
Dissolved or separate-phase CO <sub>2</sub>	Every 5 years	
Pressure	Continuous	
Temperature	Continuous	
Other parameters, including major cations and anions, selected metals, general water-quality parameters (pH, alkalinity, total dissolved solids, specific gravity), and any tracers added to the $\mathrm{CO}_2$ stream	Every 5 years	
Note: For details and information on continuous monitoring, see Table 13	3.	

# Sampling methods:

The FutureGen QASP and Testing and Monitoring Plan provide supplemental details about the sampling and analysis protocols for the direct fluid sampling that are outlined below.

Fluid samples will be collected from the monitoring wells completed in the injection zone as detailed in Table 9 above. Fluid samples will be collected using an appropriate method to preserve the fluid sample at injection zone temperature and pressure conditions. Examples of appropriate methods include using a bomb-type sampler (e.g., Kuster sampler) after pumped or swabbed purging of the sampling interval, using a Westbay sampler, or using a pressurized U-tube sampler (Freifeld et al. 2005). These types of pressurized sampling methods are needed to collect the two-phase fluids (i.e., aqueous and scCO<sub>2</sub> solutions) for measurement of the percent of water and CO<sub>2</sub> present at the monitoring location.

Fluid samples will be analyzed for parameters that are indicators of CO<sub>2</sub> dissolution, including major cations and anions, selected metals, general water-quality parameters (pH, alkalinity, TDS, specific gravity), and any tracers added to the CO<sub>2</sub> stream. Changes in major ion and trace element geochemistry are expected in the injection zone, but the arrival of proposed fluorocarbon or sulfonate tracers (co-injected with the CO<sub>2</sub>) should provide an improved early-detection capability, because these compounds can be detected at 3 to 5 orders of magnitude lower relative concentration. Analysis of carbon and oxygen isotopes in injection zone fluids and the injection stream (<sup>13/12</sup>C, <sup>18/16</sup>O) provides another potential supplemental measure of CO<sub>2</sub> migration. Where stable isotopes are included as an analyte, data quality and detectability will be reviewed throughout the active injection phase, and upon the UIC Program Director's approval, will be discontinued if these analyses provide limited benefit. Sampling and analytical techniques for target parameters are listed in Table 10 and Table 11, respectively.

# <u>Laboratory to be used/chain-of-custody procedures:</u>

See FutureGen QASP Sections B.4.3 thru B.4.7.

Table 10. Aqueous sampling requirements for target parameters.

Parameter	Volume/Container	Preservation	Holding Time
Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si,	20-mL plastic vial	Filtered (0.45 μm), HNO <sub>3</sub> to pH <2	60 days
Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl	20-mL plastic vial	Filtered (0.45 μm), HNO <sub>3</sub> to pH <2	60 days
Cyanide (CN-)	250-mL plastic vial	NaOH to pH > 12, 0.6g ascorbic acid Cool 4°C,	14 days
Mercury	250-mL plastic vial	Filtered (0.45 μm), HNO <sub>3</sub> to pH <2	28 days
Anions: Cl <sup>-</sup> , Br <sup>-</sup> , F <sup>-</sup> , SO <sub>4</sub> <sup>2-</sup> , NO <sub>3</sub> <sup>-</sup>	125-mL plastic vial	Filtered (0.45 μm), Cool 4°C	45 days
Total and Bicarbonate Alkalinity (as CaCO <sub>3</sub> <sup>2-</sup> )	100-mL HDPE	Filtered (0.45 μm), Cool 4°C	14 days
Gravimetric Total Dissolved Solids (TDS)	250-mL plastic vial	Filtered (0.45 μm), no preservation, Cool 4°C	7 days
Water Density	100-mL plastic vial	No preservation, Cool 4°C	
Total Inorganic Carbon (TIC)	250-mL plastic vial	H <sub>2</sub> SO <sub>4</sub> to pH <2, Cool 4°C	28 days
Dissolved Inorganic Carbon (DIC)	250-mL plastic vial	Filtered (0.45 $\mu$ m), H <sub>2</sub> SO <sub>4</sub> to pH <2, Cool 4°C	28 days
Total Organic Carbon (TOC)	250-mL amber glass	Unfiltered, H <sub>2</sub> SO <sub>4</sub> to pH <2, Cool 4°C	28 days
Dissolved Organic Carbon (DOC)	125-mL plastic vial	Filtered (0.45 $\mu$ m), $H_2SO_4$ to $pH$ <2, Cool 4°C	28 days
Volatile Organic Analysis (VOA)	Bottle set 1: 3-40-mL sterile clear glass vials Bottle set 2: 3-40-mL sterile amber glass vials	Zero headspace, Cool <6 °C, Clear glass vials will be UV-irradiated for additional sterilization	7 days
Methane	Bottle set 1: 3-40-mL sterile clear glass vials Bottle set 2: 3-40-mL sterile amber glass vials	Zero headspace, Cool <6 °C, Clear glass vials (bottle set 1) will be UV- irradiated for additional sterilization	7 days
Stable Carbon Isotopes $^{13/12}$ C $(\delta^{13}$ C) of DIC in Water	60-mL plastic or glass	Filtered (0.45-μm), Cool 4°C	14 days
Radiocarbon <sup>14</sup> C of DIC in Water	60-mL plastic or glass	Filtered (0.45-μm), Cool 4°C	14 days
Hydrogen and Oxygen Isotopes <sup>2/1</sup> H (δD) and	60-mL plastic or glass	Filtered (0.45-μm), Cool 4°C	45 days

Parameter	Volume/Container	Preservation	Holding Time
$^{18/16}$ O ( $\delta^{18}$ O) of Water			
Carbon and Hydrogen Isotopes ( <sup>14</sup> C, <sup>13/12</sup> C, <sup>2/1</sup> H) of Dissolved Methane in Water	1-L dissolved gas bottle or flask	Benzalkonium chloride capsule, Cool 4°C	90 days
Compositional Analysis of Dissolved Gas in Water (including N <sub>2</sub> , CO <sub>2</sub> , O <sub>2</sub> , Ar, H <sub>2</sub> , He, CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>3</sub> H <sub>8</sub> , iC <sub>4</sub> H <sub>10</sub> , nC <sub>4</sub> H <sub>10</sub> , iC <sub>5</sub> H <sub>12</sub> , nC <sub>5</sub> H <sub>12</sub> , and C <sub>6</sub> +)	1-L dissolved gas bottle or flask	Benzalkonium chloride capsule, Cool 4°C	90 days
Radon ( <sup>222</sup> Rn)	1.25-L PETE	Pre-concentrate into 20-mL scintillation cocktail. Maintain groundwater temperature prior to pre-concentration	1 day
pН	Field parameter	None	<1 h
Specific Conductance	Field parameter	None	<1 h
HDPE = high-density polyethylene; PETE = polyethylene terephthalate			

Table 11. Analytical requirements.

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Major Cations: Al, Ba, Ca, Fe, K, Mg, Mn, Na, Si,	ICP-AES, EPA Method 6010B or similar	1 to 80 µg/L (analyte dependent)	±10%	Daily calibration; blanks, LCS and duplicates and matrix spikes at 10% level per batch of 20
Trace Metals: Sb, As, Cd, Cr, Cu, Pb, Se, Tl	ICP-MS, EPA Method 6020 or similar	0.1 to 2 µg/L (analyte dependent)	±10%	Daily calibration; blanks, LCS and duplicates and matrix spikes at 10% level per batch of 20
Cyanide (CN-)	SW846 9012A/B	5 μg/L	±10%	Daily calibration; blanks, LCS and duplicates at 10% level per batch of 20
Mercury	CVAA SW846 7470A	0.2 μg/L	±20%	Daily calibration; blanks, LCS and duplicates and matrix spikes at 10% level per batch of 20
Anions: Cl¯, Br¯, F¯, SO <sub>4</sub> <sup>2</sup> ¯, NO <sub>3</sub> ¯	Ion Chromatography, EPA Method 300.0A or similar	33 to 133 μg/L (analyte dependent)	±10%	Daily calibration; blanks, LCS and duplicates at 10% level pe batch of 20
Total and Bicarbonate Alkalinity (as CaCO <sub>3</sub> <sup>2</sup> )	Titration, Standard Methods 2320B	1 mg/L	±10%	Daily calibration; blanks, LCS and duplicates at 10% level per batch of 20
Gravimetric Total Dissolved Solids (TDS	Gravimetric Method Standard Methods 2540C	10 mg/L	±10%	Balance calibration, duplicate samples
Water Density	ASTM D5057	0.01 g/mL	±10%	Balance calibration, duplicate samples
Total Inorganic Carbon (TIC)	SW846 9060A or equivalent Carbon analyzer, phosphoric acid digestion of TIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Dissolved Inorganic Carbon (DIC)	SW846 9060A or equivalent Carbon analyzer, phosphoric acid digestion of DIC	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Total Organic Carbon (TOC)	SW846 9060A or equivalent Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector.	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Dissolved Organic Carbon (DOC)	SW846 9060A or equivalent Total organic carbon is converted to carbon dioxide by chemical oxidation of the organic carbon in the sample. The carbon dioxide is measured using a non-dispersive infrared detector.	0.2 mg/L	±20%	Quadruplicate analyses, daily calibration
Volatile Organic Analysis (VOA)	SW846 8260B or equivalent Purge and Trap GC/MS	$0.3$ to $15~\mu g/L$	±20%	Blanks, LCS, spike, spike duplicates per batch of 20
Methane	RSK 175 Mod Headspace GC/FID	10 μg/L	±20%	Blanks, LCS, spike, spike duplicates per batch of 20
Stable Carbon Isotopes <sup>13/12</sup> C (1 <sup>13</sup> C) of DIC in Water	Gas Bench for <sup>13/12</sup> C	50 ppm of DIC	±0.2p	Duplicates and working standards at 10%

Parameter	Analysis Method	Detection Limit or Range	Typical Precision/ Accuracy	QC Requirements
Radiocarbon <sup>14</sup> C of DIC in Water	AMS for <sup>14</sup> C	Range: 0 i 200 pMC	±0.5 pMC	Duplicates and working standards at 10%
Hydrogen and Oxygen Isotopes $^{2/1}$ H ( $\delta$ ) and $^{18/16}$ O ( $1^{18}$ O) of Water	CRDS H <sub>2</sub> O Laser	Range: - 500‰ to 200‰ vs. VSMOW	<sup>2/1</sup> H: ±2.0‰ <sup>18/16</sup> O: ±0.3‰	Duplicates and working standards at 10%
Carbon and Hydrogen Isotopes ( <sup>14</sup> C, <sup>13/12</sup> C, <sup>2/1</sup> H) of Dissolved Methane in Water	Offline Prep & Dual Inlet IRMS for <sup>13</sup> C; AMS for <sup>14</sup> C	<sup>14</sup> C Range: 0 & DupMC	<sup>14</sup> C: ±0.5pMC <sup>13</sup> C: ±0.2‰ <sup>2/1</sup> H: ±4.0‰	Duplicates and working standards at 10%
Compositional Analysis of Dissolved Gas in Water (including $N_2$ , $CO_2$ , $O_2$ , $Ar$ , $H_2$ , $He$ , $CH_4$ , $C_2H_6$ , $C_3H_8$ , $iC_4H_{10}$ , $nC_4H_{10}$ , $iC_5H_{12}$ , $nC_5H_{12}$ , and $C_6+$ )	Modified ASTM 1945D	1 to 100 ppm (analyte dependent)	Varies by compon-ent	Duplicates and working standards at 10%
Radon ( <sup>222</sup> Rn)	Liquid scintillation after pre- concentration	5 mBq/L	±10%	Triplicate analyses
pН	pH electrode	2 to 12 pH units	±0.2 pH unit For indication only	User calibrate, follow manufacturer recommendations
Specific Conductance	Electrode	0 to 100 mS/cm	±1% of reading For indication only	User calibrate, follow manufacturer recommendations

ICP-AES = inductively coupled plasma atomic emission spectrometry; ICP-MS = inductively coupled plasma mass spectrometry; LCS = laboratory control sample; GC/MS = gas chromatography—mass spectrometry; GC/FID = gas chromatography with flame ionization detector; AMS = accelerator mass spectrometry; CRDS = cavity ring down spectrometry; IRMS = isotope ratio mass spectrometry; LC-MS = liquid chromatography-mass spectrometry; ECD = electron capture detector

# **Indirect Carbon Dioxide Plume and Pressure-Front Tracking**

FutureGen will track the CO<sub>2</sub> plume and pressure front to meet the requirements of 40 CFR 146.93(b) using integrated deformation monitoring and passive seismic monitoring.

The frequency of indirect plume and pressure-front monitoring activities during the post-injection phase, is given in Table 12 (collection and recording of continuous monitoring data will occur at the frequencies described in Table 13). The coordinates of the monitoring wells/stations are provided in Appendix C of this Plan.

Monitoring Technique	Location	Frequency (Post-Injection Phase)
Integrated deformation monitoring	5 locations (see Figure 7)	Continuous
Passive seismic monitoring (microseismicity)	Surface measurements (see Figure 7) plus downhole sensor arrays at ACZ Wells 1 and 2	Continuous

Table 12. Monitoring schedule for indirect plume and pressure-front monitoring.

#### Integrated deformation monitoring

Integrated deformation monitoring integrates ground data from permanent Global Positioning System (GPS) stations, and tiltmeters, supplemented with annual Differential GPS (DGPS) surveys, and larger-scale Differential Interferometric Synthetic Aperture Radar (DInSAR) surveys to detect and map temporal ground-surface deformation. These data reflect the dynamic geomechanical behavior of the subsurface in response to CO<sub>2</sub> injection. These measurements will provide useful information about the evolution and symmetry of the pressure front. These results will be compared with model predictions throughout the operational phase of the project and significant deviation in observed response would result in further action, including a detailed evaluation of the observed response, calibration/refinement of the numerical model, and possible modification to the monitoring approach and/or storage site operations. Integrated deformation monitoring will take place at the locations shown in Figure 7.

Passive seismic monitoring (microseismicity)

The objective of the microseismic monitoring network (Figure 7; five stations and downhole arrays in the two ACZ wells) is to accurately determine the locations, magnitudes, and focal mechanisms of any potential injection-induced seismic events with the primary goals of 1) addressing public and stakeholder concerns related to induced seismicity, 2) estimating the spatial extent of the pressure front from the distribution of any potential seismic events, and 3) identifying features that may indicate areas of caprock failure and possible containment loss. The Emergency and Remedial Response Plan (Attachment F to this permit) provides additional information about seismic monitoring).

Table 13. Sampling and Recording Frequencies for Continuous Monitoring.

Well Condition	Minimum sampling frequency: once every	Minimum recording frequency: once every
For operating injection wells that are required to monitor continuously:	5 seconds	5 minutes <sup>1</sup>
For injection wells that are shut-in:	4 hours	4 hours

<sup>&</sup>lt;sup>1</sup> This can be an average of the sampled readings over the previous 5-minute recording interval, or the maximum (or minimum, as appropriate) value identified over that recording interval

#### Notes

Sampling frequency refers to how often the monitoring device obtains data from the well for a particular parameter. For example, a recording device might sample a pressure transducer monitoring injection pressure once every two seconds and save this value in memory.

Recording frequency refers to how often the sampled information gets recorded to digital format (such as a computer hard drive). Following the same example above, the data from the injection pressure transducer might be recorded to a hard drive once every minute.

# Proposed Schedule for Submitting Post-Injection Monitoring Results

During the PISC period, monitoring reports will be prepared and submitted to the EPA Region 5 UIC office annually. The reports will summarize methods and results of the groundwater-quality monitoring, CO<sub>2</sub> storage zone pressure tracking, and indirect geophysical monitoring for CO<sub>2</sub> plume tracking. See Table 14.

Table 14. Post-injection phase reporting schedule.

Planned Testing/Monitoring	Reporting Schedule
Groundwater Quality Monitoring Data	Annual
Carbon Dioxide Plume and Pressure-Front Tracking Data	Annual
Direct Pressure Monitoring Data	Annual
Indirect Carbon Dioxide Plume and Pressure- Front Tracking Data	Annual

The PISC and Site Closure Plan will be reviewed every 5 years during the PISC period (e.g., concurrent with or as a result of 5-year reevaluations of the AoR). Results of the plan review will be included in the PISC monitoring reports. Monitoring and operational results will be reviewed for adequacy in relation to the objectives of PISC monitoring. The monitoring locations,

methods, and schedule will be analyzed in relation to the size of the CO<sub>2</sub> storage zone, pressure front, and protection of USDWs. In case of changes to the PISC plan, a modified plan will be submitted to the EPA Region 5 UIC Branch Office for not less than 30 days prior to the planned intiation of the changes.

### **Alternative Post-Injection Site Care Time Frame**

FutureGen is not requesting an alternative PISC time frame.

# **Non-Endangerment Demonstration Criteria**

Prior to approval of the end of the PISC period, FutureGen will submit a demonstration of non-endangerment of USDWs to the UIC Program Director (40 CFR 146.93(b)(3)).

FutureGen will issue a report to the UIC Program Director. This report will make a demonstration of USDW non-endangerment based on the evaluation of the site monitoring data used in conjunction with the project's computational model. The report will include information detailing how the non-endangerment demonstration evaluation uses site-specific conditions to confirm and demonstrate non-endangerment. The report will include all relevant monitoring data and interpretations upon which the non-endangerment demonstration is based and any other information necessary for the UIC Program Director to replicate the analysis. The report will include the sections discussed below.

# **Summary of Existing Monitoring Data**

A summary of all previous monitoring data at the site, including data collected during the injection and PISC phases of the project, will be submitted to help demonstrate non-endangerment. Data submittals will be in a format acceptable to the UIC Program Director (40 CFR 146.91(e)), and will include a narrative explanation of monitoring activities, including the dates of all monitoring events, changes to the monitoring program over time, and an explanation of all monitoring infrastructure that has existed at the site.

#### Comparison of Monitoring Data and Model Predictions and Model Documentation

The results of computational modeling used for AoR delineation will be compared to monitoring data collected during the operational and the PISC period. Monitoring data will also be compared with baseline data collected during site characterization, per 40 CFR 146.82(a)(6) and 146.87(d)(3). The data will include time-lapse temperature, pressure, ground water analysis, passive seismic, and geophysical surveys; i.e. logging, and 3D surface seismic surveys, used to update the computational model and to monitor the site. Data generated during the PISC period will be used to show that the computational model accurately represents the storage site and can be used as a proxy to determine the plume's properties and size. FutureGen will demonstrate this degree of accuracy by comparing the monitoring data obtained during the PISC period against the model's predicted properties (i.e., plume location, rate of movement, and pressure decay). Statistical methods will be employed to correlate the

data and confirm the model's ability to accurately represent the storage site. The validation of the computational model with the large volume of available data will be a significant element to support the non-endangerment demonstration. Further, the validation of the complete model over the areas, and at the points, where direct data collection has taken place will ensure confidence in the model for those areas where surface infrastructure preclude geophysical data collection and where there are no direct observation wells.

#### **Evaluation of Carbon Dioxide Plume**

FutureGen will use a combination of monitoring data, logs, geophysical surveys, and seismic methods to locate and track the movement of the CO<sub>2</sub> plume. Seismic surveys will be employed to determine the plume location at specific times. The data produced by these activities will be compared against the modeled predictions (see Figure 6) using statistical methods to validate the model's ability to accurately represent the storage site. Regarding the separate-phase carbon dioxide plume, the PISC monitoring data will show the stabilization of the CO<sub>2</sub> plume as the reservoir pressure returns to its near pre-injection state. For the separate-phase carbon dioxide plume, the risk to USDWs will decrease when the extent of pure-phase carbon dioxide ceases to grow either laterally or vertically. The stabilization of the plume combined with the lack of local penetrations of the confining formation will be significant factors in FutureGen's demonstration of non-endangerment. Furthermore, FutureGen's monitoring wells screened above the confining layer may be used to determine aqueous-phase concentrations of carbon dioxide and mobilized constituents in order to assess USDW endangerment. If a demonstration can be made, in conjunction with monitoring data, that a vast majority of the carbon dioxide has been immobilized via trapping mechanisms, this is strong evidence that the risk to USDWs posed by the carbon dioxide plume has decreased. Modeling may also be used to estimate future plume migration. Modeling results, including sensitivity analyses, may be used to demonstrate that plume migration rates are negligible based on available site characterization, monitoring, and operational data.

#### **Evaluation of Mobilized Fluids**

In addition to carbon dioxide, mobilized fluids may pose an ongoing risk to USDWs. These include native fluids that are high in TDS and therefore may impair a USDW, and fluids containing mobilized drinking water contaminants (e.g., arsenic, mercury, hydrogen sulfide). The geochemical data collected from monitoring wells will be used to demonstrate that no mobilized fluids have moved above the confining formation and, therefore after the PISC period, would not pose a risk to USDWs. Of particular importance are any monitoring wells that are screened above the primary confining zone, within any USDWs, and in the vicinity of any known leakage pathways. Monitoring data indicating steady or decreasing trends of potential drinking water contaminants below actionable levels (e.g., secondary and maximum contaminant levels) will be used for this demonstration. In order to demonstrate nonendangerment, FutureGen will compare the operational and PISC period samples of the lowermost USDW against the pre-injection baseline samples. This comparison will show that no significant changes have occurred in the fluid properties of the overlying formations. This will demonstrate that no mobilized formation fluids have moved through the confining

formation. This validation of confining zone integrity will demonstrate that the injectate and/or mobilized fluids would not represent an endangerment to any USDWs.

#### **Evaluation of Reservoir Pressure**

FutureGen will also demonstrate non-endangerment to USDWs by showing that during the PISC period, the pressure within the Mount Simon rapidly decreases to its near pre-injection static reservoir pressure. Because the increased pressure is the primary driving force for fluid movement that may endanger a USDW, the decay in the pressure differentials will provide strong justification that the injectate no longer poses a risk to any USDWs.

FutureGen will monitor the downhole reservoir pressure at various locations and intervals using a combination of surface and downhole pressure gauges. The measured pressure at a specific depth interval will be compared against the pressure predicted by the computational model (see Figures 1 and 2). Agreement between the actual and the predicted values will validate the accuracy of the model and further demonstrate non-endangerment.

# **Evaluation of Potential Conduits for Fluid Movement**

Other than the project and monitoring wells, other distant potential conduits for fluid movement, or leakage pathways within the AoR are adequately constructed and/or plugged. Based on this information, the potential for fluid movement through artificial penetrations of the confining formation does not present a risk of endangerment to any USDWs.

#### **Evaluation of Passive Seismic Data**

Seismic monitoring will be used to further demonstrate confining formation integrity. FutureGen will provide seismic monitoring data showing that no seismic events have occurred that would indicate fracturing or fault activation near or through the confining formation. This validation of confining zone integrity will provide further support to demonstrate that the CO<sub>2</sub> plume is no longer an endangerment to any USDWs, by indicating that the response to the imposed fluid pressures due to injection are confined to the vicinity of the injection zone and below.

# Site Closure Plan

FutureGen will conduct site closure activities to meet the requirements of 40 CFR 146.93(e). Site closure will occur at the end of the PISC period. Site closure activities will include decommissioning surface equipment, plugging monitoring wells, restoring the site, and preparing and submitting site closure reports.

The EPA Region 5 UIC Branch Office will be notified at least 120 days before site closure. In addition, state and local agencies including the Illinois State Geological Survey and Illinois Department of Natural Resources, as well as City of Jacksonville and Morgan County agencies will be notified prior to the scheduled site closure. At this time, there are no federally recognized Native American Tribes located within the AoR or the State of Illinois. If a federally recognized

Native American Tribe exists in the AoR or the State of Illinois at the time of site closure, it will be notified of site closure at that time.

A revised site closure plan will be submitted to the EPA Region 5 UIC Branch Office and state and local (and tribal) governmental agencies, if any changes have been made to the original site closure plan. After site closure is authorized, site closure field activities will be completed.

#### **Planned Remedial/Site Restoration Activities**

At the end of the PISC phase, FutureGen will ensure the site is reclaimed and returned to predevelopment condition to meet the requirements of 40 CFR 146.93(e).

Surface equipment decommissioning will occur in two phases: the first phase will occur after the active injection phase, and the second phase will occur at the end of PISC phase. The surface facilities at the storage site will include the Site Control Building and the WAPMMS (Well Annular Pressure Maintenance and Monitoring System) Building.

At the end of the active injection period, plume monitoring will continue, but there will be no further need for the pumping and control equipment. The Site Control Building will be demolished. All features will be removed except the WAPMMS Building, a 12-ft-wide access road with five parking spaces, a concrete sidewalk from the parking lot to the building, underground electrical and telephone services, and a chain-link fence surrounding the building. The common wall between the WAPMMS Building and the Site Control Building will be converted to an exterior wall. The injection wells will be plugged and capped below grade (see the Injection Well Plugging Plan in Attachment D of this permit). The gravel pad will be removed. The WAPMMS Building at the storage site will be repurposed to act as the collection node for data from the plume monitoring equipment. The building will contain equipment to receive real-time data from the monitoring wells and other monitoring stations and send the data via an internet connection to be analyzed offsite during the 50-year post-injection monitoring period.

All surface facilities will be removed at the end of the PISC phase. These facilities will include the WAPMMS Building, the access road with parking spaces, all sidewalks, underground electrical and telephone services, and fencing at the injection well sites. The site will be reclaimed and returned to predevelopment condition.

Soil will be backfilled around the monitoring and geophysical wells to bring the area around the wells back to pre-well-installation grade. Any remaining surface facilities associated with the monitoring well will be reclaimed and the area will be returned to predevelopment condition. All gravel pads, access roads, and surface facilities will be removed, and the land will be reclaimed for agricultural or other beneficial pre-construction uses.

#### **Plugging the Monitoring Wells**

Upon conclusion of the post-injection site care period (~50 years), all monitoring wells will be plugged and capped below grade in accordance with the approved monitoring well Plugging and Abandonment Plans (see Appendix E of this Plan). All deep monitoring wells at the site will be

plugged to prevent any upward migration of the CO<sub>2</sub> or formation fluids into USDWs. Each of the deep monitoring wells will be plugged and abandoned using best practices to prevent communication of fluids between the injection zone and USDWs. The deep monitoring wells in the injection interval have a direct connection between the injection formation and ground surface. The well-plugging program is designed to prevent communication between the injection zone and the USDWs.

Before the wells are plugged, the internal and external integrity of the wells will be confirmed by conducting cement-bond, temperature, and noise logs on each of the wells. In addition, a pressure fall-off test will be performed above the perforated intervals (where present) to confirm well integrity. The results of the logging and testing will be reviewed and approved by appropriate regulatory agencies prior to plugging the wells.

The wells with perforations (the SLR monitoring wells, the ACZ monitoring wells, and lowermost USDW monitoring well) will be plugged using a CO<sub>2</sub>-resistant cement retainer method to cement the perforated intervals and a balanced plug method to cement the well above the perforated zones and the cement retainer. The RAT monitoring wells will not have perforations; therefore, only the balanced plug method will be used to plug these wells. Once the interior of the casing has been properly plugged with cement, the casing will be cut off below ground and capped. Regulations at the time of the plugging and abandonment will dictate the specifications regarding the depth at which the casing is cut and the method used to cap the well. The cap will be inscribed with the well identification number and the date of plug and abandonment.

# Plugging the Geophysical Wells

The FutureGen microseismic and deformation monitoring designs include five geophysical monitoring stations. Two types of well completions will be constructed at each of the five geophysical monitoring stations: both well types will be completed as sealed access tubes designed to support downhole installation of either microseismic or tiltmeter instrumention in a subsurface moisture free environment. Well construction and plugging schematics showing the exposed formation intervals, casing diameters, casing depths, depths to USDWs, and the placement of all plugs are presented for each well type in Figure 9.

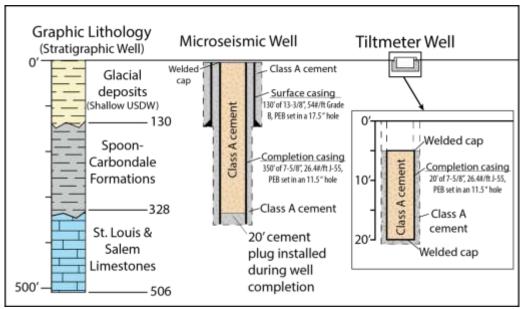


Figure 9. Diagram of Microseismic and Tiltmeter Wells After Plugging and Abandonment.

Upon conclusion of the post-injection site care period, all geophysical wells will be plugged and capped below grade in accordance with the approved monitoring well Plugging and Abandonment Plans (see Appendix E of this plan). All downhole instrumentation will be removed and each microseismic well casing and tiltmeter well casing will be plugged with cement to ensure that the well does not provide a conduit to the shallow USDW zone or ground surface. The procedures for plugging and abandoning both types of wells are very similar. However, cement volumes will differ depending upon the total depth of the well.

For both well-completion designs, class A cement will be used to plug the well casing. The geophysical wells will not have perforations; therefore, the balanced plug method will be used to plug these wells. Once the interior of the casing has been properly plugged with cement, the casing will be cut off below ground and capped. Regulations at the time of the plugging and abandonment will dictate the specifications regarding the depth at which the casing is cut and the method used to cap the well. The cap will be inscribed with the well identification number and the date of plug and abandonment.

The methods and materials described in this plan are based upon current understanding of the geology at the site and current well designs. If necessary, the plans will be updated to reflect the latest well designs. These new designs, materials, and methods will be described in the Notice of Intent to Plug submitted at least 60 days prior to the plugging of the wells.

After the completion of the plugging activities, a plugging report will be submitted to the UIC Program Director describing the methods used and tests performed on the well during plugging. This report will be submitted to the UIC Program Director within 60 days of completing the plugging activities.

### **Site Closure Reporting**

A site closure report will be submitted to the EPA Region 5 UIC Branch Office and the previously notified state and local regulatory agencies within 90 days of site closure. The site closure report will include the following information:

- Documentation of appropriate well plugging, including a survey plat of the injection well location;
- Documentation of the well-plugging report to Illinois and local agencies that have authority over drilling activities at the facility site; and
- Records reflecting the nature, composition, and volume of the CO<sub>2</sub> injected in UIC wells.

In association with site closure, a record of notation on the facility property deed will be added to provide any potential purchaser of the property with the following information:

- Notification that the subsurface was used for CO<sub>2</sub> storage;
- The name of the Illinois and local agencies and the EPA Region 5 Branch Office to which the survey plat was submitted; and
- The volume of fluid injected, the injection zone, and the period over which injection occurred.

PISC and site closure records will be retained for 10 years after site closure. At the conclusion of the 10-year period, these records will be delivered to the EPA Region 5 UIC Branch Office for further storage.

# **APPENDIX A: Deep Monitoring Well Locations**

Well ID	Well Type	Latitude (WGS84)	Longitude (WGS84)
ACZ1	Above Confining Zone 1	39.80034315	-90.07829648
ACZ2	Above Confining Zone 2	39.80029543	-90.08801028
USDW1	Underground Source of Drinking Water	39.80048042	-90.0782963
SLR1	Single-Level in-Reservoir 1	39.8004327	-90.08801013
SLR2	Single-Level in-Reservoir 2	39.80680878	-90.05298062
RAT1	Reservoir Access Tube 1	39.80035565	-90.08627478
RAT2	Reservoir Access Tube 2	39.78696855	-90.06902677
RAT3	Reservoir Access Tube 3	39.79229199	-90.08901656

# **APPENDIX B: Surficial Aquifer Monitoring Well Locations**

Well ID	Well Type	Latitude	Longitude
FG-1	FutureGen Shallow Monitoring Well	39.80675	-90.05283
FGP-1	Private Well	39.79888	-90.0736
FGP-2	Private Well	39.78554	-90.0639
FGP-3	Private Well	39.79497	-90.0746
FGP-4	Private Well	39.79579	-90.0747
FGP-5	Private Well	39.81655	-90.0622
FGP-6	Private Well	39.81086	-90.057560
FGP-7	Private Well	39.81444	-90.065241
FGP-9	Private Well	39.80829	-90.0377
FGP-10	Private Well	39.81398	-90.0427

## **APPENDIX C: Microseismic Monitoring and Integrated Deformation Station Locations**

Well ID/Station ID	Well/Station Type	Latitude (WGS84)	Longitude (WGS84)
MS1	<ul><li>Microseismic monitoring Station 1(shallow borehole)</li><li>Integrated deformation monitoring station</li></ul>	39.8110768	-90.09797015
MS2	<ul><li>Microseismic monitoring Station 2 (shallow borehole)</li><li>Integrated deformation monitoring station</li></ul>	39.78547402	-90.05028403
MS3	<ul><li>Microseismic monitoring Station 3 (shallow borehole)</li><li>Integrated deformation monitoring station</li></ul>	39.81193502	-90.06016279
MS4	<ul><li>Microseismic monitoring Station 4 (shallow borehole)</li><li>Integrated deformation monitoring station</li></ul>	39.78558513	-90.09557015
MS5	<ul><li>Microseismic monitoring Station 5 (shallow borehole)</li><li>Integrated deformation monitoring station</li></ul>	39.80000524	-90.07830287
ACZ1	· Deep microseismic station (deep borehole)	39.80034315	-90.07829648
ACZ2	Deep microseismic station (deep borehole)	39.80029543	-90.08801028

APPENDIX D: Planned Construction Design and Plugging and Abandonment Plan Diagrams for Deep Monitoring Wells and Reservoir Access Tube Wells

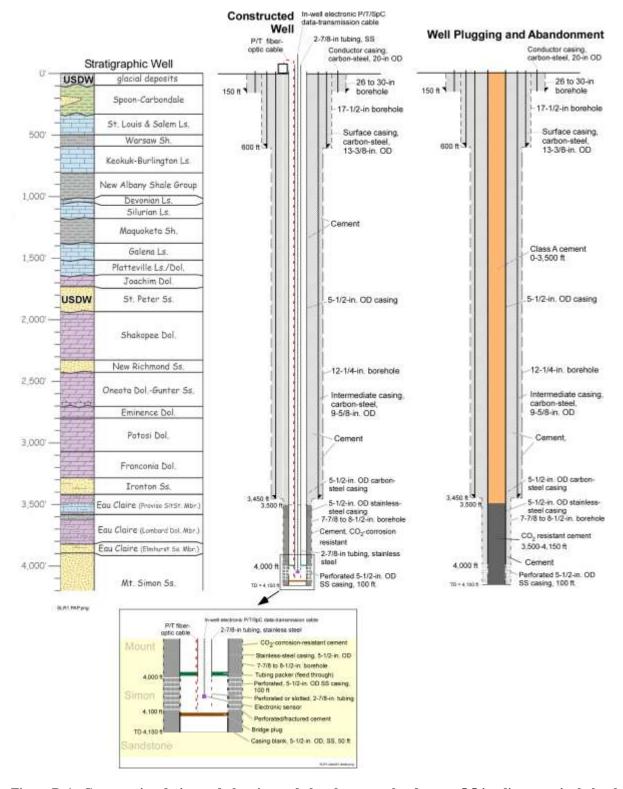


Figure D-1. Construction design and plugging and abandonment plan for new 5.5-in.-diameter single-level in-reservoir monitoring well.

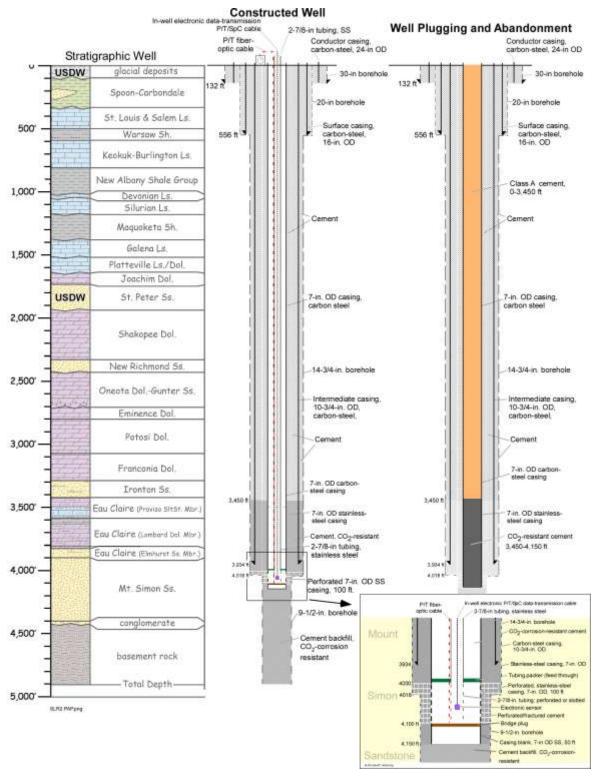


Figure D-2. Construction design and plugging and abandonment plan for 7-in.-diameter single-level inreservoir monitoring well to be reconfigured from the stratigraphic well.

#### Constructed Well

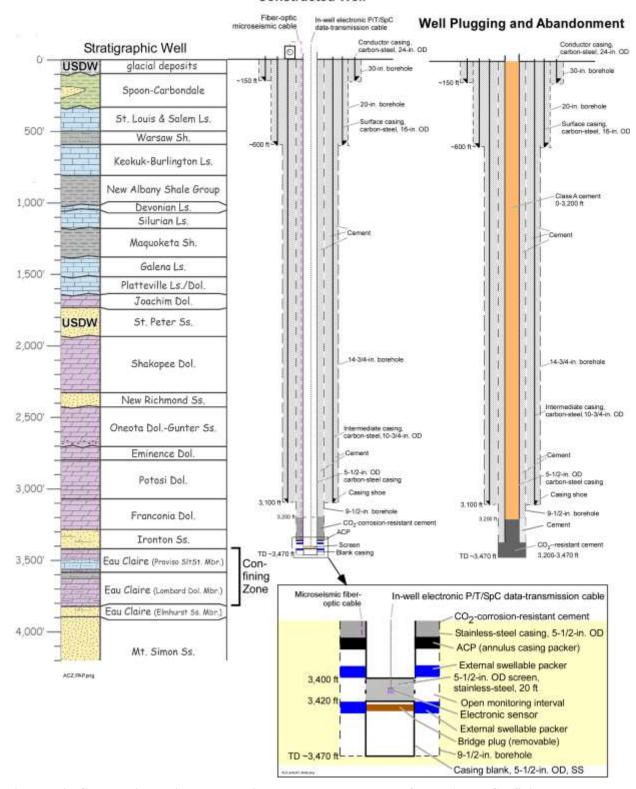


Figure D-3. Construction design and plugging and abandonment plan for the Above Confining Zone monitoring wells.

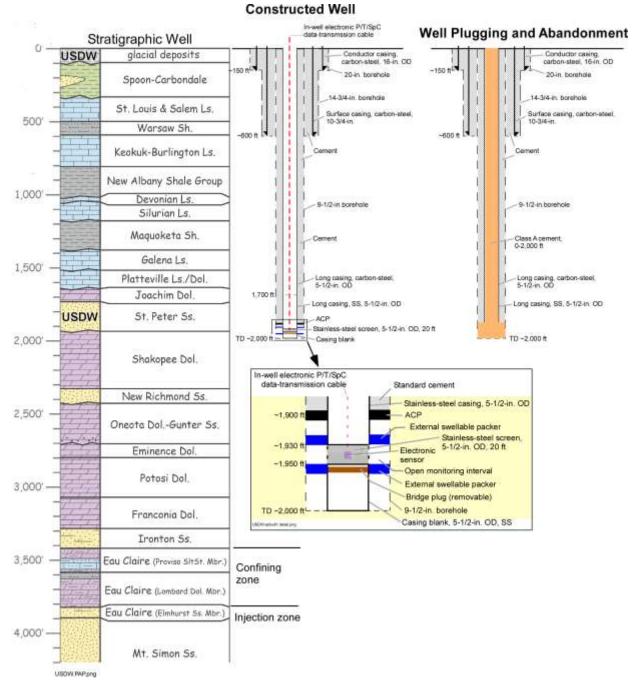


Figure D-4. Construction design and plugging and abandonment plan for the USDW monitoring well.

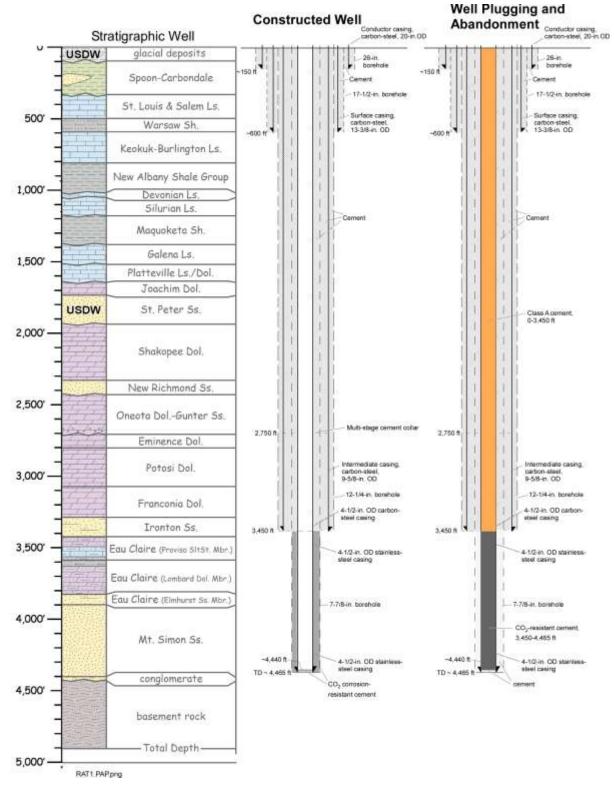


Figure D-5. Construction design and plugging and abandonment plan for the reservoir access tube wells.

# APPENDIX E:Plugging and Abandonment Plans for Deep Monitoring Wells, Reservoir Access Tube Wells, and Geophysical Wells

Plugging and abandonment plans for the following monitoring wells are provided in this appendix:

## Monitoring wells

- ACZ1
- ACZ2
- RAT1
- RAT2
- RAT3
- SLR1-5.5"
- SLR2-7"
- USDW1

## **Geophysical Wells**

- MS1
- MS2
- MS3
- MS4
- MS5
- TM1
- TM2
- TM3
- TM4
- TM5

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* =	<del>                                      </del>		- <del>-</del> -		Are Rul	vidual Pem a Pennit e r of Wells		TION	□ E	IS I IS II rine Dispos Inhanced Re ydrocarbon IS III	covery		
			0.000		-	-		1				M028	
	200	SING AND TUB	ING RECORD			70		1000	OD OF EMPL	ACEMENT O	F CEMENT P	LUCS	
SIZE	WT (LB/FT)	TO BE PUT IN	WELL (FT)		LEFT IN W	/ELL (FT)	HOLE SIZ	E Th	e Balance Mo	thod			
20"	94	0-150		150		26"		Th	e Dump Baile	r Method			
13-3/8		0-600		600		17.5"		Th	e Two-Plug N	lethod			
9-5/8"		0-3,450		3.450			12.25"	Ot	her				
4-1/2"	- A V 10 .	0-4,465		4,465			7.875"						
	CEMENTING	TO PLUG AND	ABANDON DA	ATA:		PLUG #1	PLUG #	PLUG #3	PLUG #4	PLUG 45	PLUG #6	PLUG #7	
		which Plug Will		inche		4,5"	4.5"						
-		ing or Drill Pip	Harris			4,440'	3,450'						
_		Used (each plu	g):			79	262						
	tume To Be Pi					89	309	_					
	ed Top of Plug	A CONTRACTOR OF THE PARTY OF TH				3,450	0						
	d Top of Plug (	if tagged ft.)				3,450	0	-					
	t. (Lb/Gal.)					15.82	15.6	-				_	
Type Cer		daterial (Class I				_	Class A						
1		T ALL OPEN H	OLE AND OR		ATED INT	ERVALS AN	D INTERVA		ING WILL BE	VARIED (if a	-		
	From			To				From			To		
_		- 3	-			- 1			$\rightarrow$				
_			-										
		-				-			$\rightarrow$				
Estimate	d Cost to Plug	Wells											
8,8062		200000											
						Certifica	tion						
		e penalty of law			y examine	ed and am f	amiliar with	the informatio					

Name and Official Title (Please type or print)

Kenneth K. Humphreys, Chief Executive Officer

Date Signed

₽E	PA		PLL	United S	Washi	ngton,	DC 20460		PI	ΔN					
1 Carron 100	nd Address of F LR1, Future G				7,110	-1	lame and A FutureGen	ddress of C	hime		ville, IL 626	50			
	cate Well and C		Š	1,300	ate llinois			County			Permit	Number			
Se	ction Plat - 640	Acres		, Adjun	urface Loc	ation D	an a cintian	(2024) Spinit			_				
150	200 - N - N	N		9550	many ya	enaming .	(girotholoing)	1777		Take 1	TE CONTRACTOR	rem III	Own		
		10.0		100	1/4 of 3	W 11.4	of SW 1/4	of HW 1/4	of	Section 26	Township	1011 Range	94		
_	†	-  - -  -		Su	ecation ft.	ft. fri	n (N.S)	Line of quart	arte		2778000 54.3-25	drilling unit			
	1 1 1		1	1	Individ	ual Per	mit			CLAS	SS 1				
-	<del></del>			1	Area Pe	enn it				CLAS	SS II				
	1-1-1	-		,	Rule Number of	Wells	1				irine Dispos nhanced Re lydrocarbon SS III	covery			
G		s		20						250000000	0.00				
				Le	ase Name					Well Num	ber				
	CA	SING AND TU	BING RECOR	AFTER PL	UGGING			- 1	METH	OD OF EMPL	ACEMENT O	FCEMENTP	LUGS		
SIZE	WT (LB/FT)	TO BE PUT I	N WELL (FT)	TO BE LE	FT IN WELL	(FT)	HOLE SIZ	E D	Th	e Balance Mo	thed				
20"	0.4	0-150		150			26"	1 F		e Dump Baile					
13-3/8	HTT: 15-550 - 357-					-	17.5**	7 F	2000	e Two-Plug N					
9-5/8"	36	0-3,450		3,450		-	12.25" Other								
5-1/2"	17	0-4.150		4.150		-	8"	-							
-	-	TO PLUG AND	ABANDONO	Name and Address of the Owner, where the Owner, which the	T p	LUG /	_	2 PLUG	112	PLUG #4	PLUC #5	PLUG #6	PLUG #7		
F100 001	tole or Pipe in			7000		-1/2"	5-1/2"	2 7200		1200 114	7200 10	PLOG NO	120017		
-	Bottom of Tub			NACTOR.		-	3,500	_	_	_	_	_			
PROPERTY AND PERSONS NAMED IN	Cement To Be	and a second or second or second or second	ALC: NO PERSONS ASSESSMENT OF THE PERSONS ASSESSMENT ASSESSMENT ASSESSMENT ASSESSMENT ASSESSMENT		7	150'	388	-	_						
_	otume To Be Pi		-91		8		458	_	_						
	ed Top of Plug				- 100	_	10'	_	_				_		
	d Top of Plug (					500'	0,	-	_	_					
***********	t. (Lb/Gal.)	in california (c.)			- 100	5.82	15.6	_	_						
	ment or Other f	Antonial (Class	100					_	_	_			_		
Type ce			-			verCre	_	-					_		
3		T ALL OPEN F	OLE AND/OR		ED INTERV	ALS A	ID INTERVA		CAS	ING WILL BE	VARIED (IT I				
	From			To		-		From		-		То			
4000"			[4][00] (Det	forated and	fractured				_	-			_		
-			1			-				-					
			-			-				$\rightarrow$					
Estimat	ed Cost to Plug	Wells	1			_ 1			_						
\$536,6	-	Wells													
	ertify under the				xamined a		familiar with								
im	formation is tru essibility of fine	e, accurate, a	nd complete.	I am aware	that there										
Name ar	nd Official Title	(Please type	or print)		Signatu	ire						Date Signed	1		
Kennel	and Official Title (Please type or print) neth K. Humphreys, Chief Executive Officer		er		8	will	21 7	1/2	uplue.	1.6	03/03/201	1			

₽E	PA	P	United St	Washington	DC 204	80		AN			
900,000,000	d Address of F LR2, Puture G				Name an	d Addr	ess of Owne	Operator	ville, IL 626	50	
	cate Well and C		Sta	nois		C	ounty forgan			Number	
	POST FIRE SHOT	727	Su	rface Location	Description	or					
		N I	nw.	1/4 of no 1/	4 of me	1/4 of	90 1/4 of	Section 25	Township	16n Range	9w
* -	<del>  -   -   -   -   -   -   -   -   -   -</del>		E E	tt. from (	m (N-S) E-W)	Line	ne of quarter of quarter se	section ction.	WELL /	ACTIVITY	
F	<del> </del>	<b>-</b>  - - -		umber of Wells	1				nhanced Re lydrocarbon	covery	
- St		s	J L+s	see Name				Well Num	ss III ber		
	CA	SING AND TUBING REC	ORD AFTER PLU	IOOING			METH	OD OF EMPL	ACEMENT O	F CEMENT P	LUCS
SIZE	WT (LB/FT)	TO BE PUT IN WELL (F	TI TO BE LEF	T IN WELL (FT)	HOLE	SIZE	[7] to	e Balance Me			
24"	140	0-132	132		30"		annie .	e Barance IXX e Dump Baile			
16"	84	0-556	556		20"		-	e Dump Ball e Two-Plug N			
10-3/4	51	0-3.934	3.934		14.75	+	e i wo-riug n	recipe			
7"	29	4.150	4.150		9.5"						
	CEMENTING	TO PLUG AND ABANDO	N DATA:	PLUG	T PLU	IG #2	PLUG #3	PLUG #4	PLUC #5	PLUG #6	PLUG #T
Size of I	folie or Pipe in	which Plug Will Be Plac	ed (inche	7"	7"	-					
Depth to	Bottom of Tub	ling or Drill Pipe (ft		4,150	3,50	10'				1	
Backs of	Cement To Be	Used (each plug)		124	619						
Slurry V	otuma To Be Pi	imped (cu. ft.)		139	730						
Calculat	ed Top of Plug	(rt.)		3,500	0.						
Measure	d Top of Plug (	if tagged ft.)		3,500"	0,						
Sturry W	rt. (Lb./Gal.)			15.82	15.6	5					
Type Ce	ment or Other f	daterial (Class III)		EverO	ret Cla	88 A					
3	Lis	T ALL OPEN HOLE AND	OR PERFORATE	D INTERVALS	AND INTE	RVALS	WHERE CAS	ING WILL BE	VARIED (if a	iny)	
	From		To				From			To	
4000		4100' (	perforated and )	fractured)							
	4 5 - 14 1 1 1	W.W.									
\$571,6	ed Cost to Plug 600	Wells									
at in	tachments and formation is tru	e penaity of law that I ha that, based on my inqui le, accurate, and comple and imprisonment. (R	iry of those indiv ite. I am aware i	viduals immedia that there are s	familiar	onsibl	e for obtaining	ng the inform	ration, I beli	eve that the	
Name ar	ed Official Title	(Please type or print)	2111	Signature	90 22	0-51 m		0.00		Date Signed	E .
Kennel	h K. Humphre	rys, Chief Executive O	fficer	28	net	1 7	of the	nder	1.5	03/03/201	13

						OMB No. 2040	1-0042 Ap	proval Expir	es 11/30/2014	6
^-	-		United States	Environme Washington		on Agency				
₽E	PA	PLI	JGGING AI			MENT PI	_AN			
Name an	d Address of F	acility			Name and A	ddress of Own	er/Operator			
Well t	SDW1, Futur	eGen 2.0, Morgan Count	y, IL		FutureGer 73 Centra	i Alliance I Park Plaza I	ast, Jackson	ville, IL 620	550	
	rate Well and C		State Illinoi	8		County		Permit	Number	
500	tion Plat - 640 /	tcres	1	e Location D	Description	1		_		
_		N .	arminent .	The second second		at 90 1/4 of	Section 26	Township	160 Ranne	9w
-	<del> - - -</del>  - - - -  - - - -			well in two	directions f	Line of quarters	es of quarter	7 - 1 - 1 - 1 - 1 - 1		
w <u>-</u>	<del>                                     </del>	<del></del>	Z  In	TYPE OF idividual Per rex Pennit ule per of Wells	AUTHORIZA em it		CLA	SS I SS II Brine Dispos Enhanced Re Hydrocarbon SS III	covery	
		57 = 2	Lease 3	-			Well Num	-		
			D AFTER PLUGGI	NG		MET	HOD OF EMP	LACEMENT O	FCEMENTP	LUGS
BIZE		TO BE LEFT IN	WELL (FT)	HOLE SE	ZE V T	he Balance M	othod			
16"	" 55 0-150 1:				20"		he Dump Bail	er Method		
10-3/4	40.5	0-600	600		14.75"	4 07	he Two-Plug I	Nethod		
5-1/2"	17	0-2,000	2,000	_	9.5"	- Lº	ther			
		II.	1	I some	1	PLUG #3	PLUG #4	PLUG #5	PLUG A6	PLUG #7
Elta of I	112077770017	TO PLUG AND ABANDON C which Plug Will Be Placed	20,000	PLUG #	1 PLUG	FLUG NO	PL00 //4	PLUG 46	PLUG NE	PLUG #7
		ung or Drill Pipe (ft.	(Hereston)	2,000'	1,880'		1		-	-
THE REAL PROPERTY.	THE RESERVE AND ADDRESS OF THE PARTY OF	Used (each plug)		56	209		-			
_	oluma To Be Pu	THE RESERVE OF THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN		63	246	_	_			
	ed Top of Plug			1,880	0		-			
Measure	d Top of Plug (	if tagged ft.)		1,880'	0	111				
Sturry W	t (Lb/Gal.)			15.6	15.6					
Type Ce	ment or Other f	daterial (Class III)		Class A	Class	A				
1	LIS	T ALL OPEN HOLE AND/OF	R PERFORATED IN	TERVALS A	ND INTERVA	LS WHERE CA	SING WILL BE	VARIED (if	arry)	
	From		To	T		From			To	
2.000		1,880' (pe	rforated)	- 3	1					
1,930		1,950' (sc	reened)							
-										
2319.0 0,0162	ed Cost to Plug 100	Wells								
at in po	tachments and formation is tru ssibliity of fine	e penalty of law that I have that, based on my inquiry is, accurate, and complete and imprisonment. (Ref. (Please type or print)	of those individua I am aware that 40 CFR 144.32)	als immedia there are si	familiar wit tely respon- gnificant pe	sible for obtain naities for sub	ing the infon mitting false	nation, I beli information,	eve that the	•
				gradine	114	H. Ha	nolin	4		
Kennel	n K. Hümphre	rys, Chief Executive Offi	cer	200	THE PERSON		/	W. T.	03/03/201	4:

decision.	nd Address of F		LEC	JGGING	AND A	BAI	NDONM	ENT PL	AN			
		actity n 2.0, Morgan	County, IL			F	utureGen A	ress of Owne Iliance ark Plaza Ea		/ille, IL 626	50	
1 B (28				Sta	ite	1	C	ounty		Permit	Number	
	cate Well and C ction Plat - 640			11	inois			Morgan				
_		N	_	grett	face Locatio		general contract	11W 1.4 of	Section 27	Township	16n Range	9w
-	<del> </del>	<b>+</b> ++	<del> </del> -   -	Su	rface cation ft d ft fron	frin	(N.S)L	n nearest line ine of quarter of quarter se	section	279-0000-0-000	drilling unit	Š
w	<del> </del> -	5	†- †-		Area Penni Rule	Perm				IS I IS II rine Dispos: nhanced Re lydrocarbon	u covery	
		SING AND TUBI					METU	_	ACEMENT O	E CEMENT D	ues	
SIZE	WT (LB/FT)	TO BE PUT IN		T IN WELL (F	- T	HOLE SIZE	-1188			O.C.III.		
13-3/8	54 54	0-130	WELL (FI)	130	I IN WELL (P	-	17.5"	and a	Balance Me			
7-5/8	26.4	0-350		350			11.5"	-	Dump Saile			
		1000000		1		14.4		The Two-Plug Method Other				
		0.		li .					307			
	CEMENTING	TO PLUG AND A	BANDON D	ATA:	PLU	3 //1	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #1
Bize of	Hole or Pipe in	which Plug Will I	Be Placed	inche	7-5/8	300					3000,0000	
Depth t	Bottom of Tub	ing or Drill Pipe	(ft		330	_						
_		Used (each plug	):		74	_						
	otume To Be Pi				87	_	_					
	ed Top of Plug ed Top of Plug (				0	_	_					_
-	/t. (Lb./Gal.)	in collidate (c)			15.6	_	-					
		daterial (Class III			Clas	: A				1		
	ĹIS	T ALL OPEN HO	LE AND/OR	PERFORATE	-	_	INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	mr)	
	From	T	== 1-10.55	To		Т		From	T		To	
		31										
-												
\$25,00	ed Cost to Plug 00	Wells										
	W CONT	2 8 1		00.	Certif	C,ESS		ha lafara sila	a submitted	in this docum		
at in	formation is tru	e penaity of law t that, based on n ie, accurate, and and imprisonme	on plete.	f those indi	viduals imme that there are	diate	y responsible	le for obtainin	ng the inform	ation, I belie	eve that the	

Knett & Hamplings

EPA Form 7520-14 (Rev. 12-11)

Kenneth K. Humphreys, Chief Executive Officer

θE	PA	PL	United States I W UGGING AN	ashington,	DC 20460		AN						
400000000000000000000000000000000000000	d Address of F 152, FutureGe	aciity n 2.0, Morgan County, I	L		Name and Address of Owner/Operator  Future-Gen Alliance 73 Central Park Plaza East, Jacksonville, IL 62650								
1.0	ate Well and C	outline Unit on	State		1.15	County		Permit	Number				
	tion Plat - 640		Illinois			Morgan							
_		N	proved .	Location D of SW 1/4	gerbaning .	f HW 1/4 of	Section 31	Township	16n Range	9w			
-	<del> </del>		Surface Location and	ft. from (E	m (N:S)	in nearest line Line of quarter of quarter se	section	277800054353	drilling unit	8			
(H)	<del> </del>		Rul	er of Wells			CLA	is II Irine Dispos Inhanced Re Iydrocarbon	covery				
			Lease Na			1	Well Num			Market 1			
		SING AND TUBING RECOR					OD OF EMPL	ACEMENT O	F CEMENT P	LUCS			
SIZE	WT (LB/FT)	TO BE PUT IN WELL (FT)	TO BE LEFT IN W	VELL (FT)	HOLE SIZE	☑ Th	e Balance Mo	thod					
13-3/8	54	0-130	130		17.5"	Th	e Dump Baile	r Method					
7-5/8	26.4	0-350	350		11.5"	☐ Th	e Two-Plug N	lethod					
			_	_		Ott	ner .						
		I.	1	_	-	_				-			
	112000000000000000000000000000000000000	TO PLUG AND ABANDON I	24,000	PLUG #	1 PLUG #2	PLUG #3	PLUG #4	PLUC #5	PLUG #6	PLUG #7			
-		which Plug Will Be Placed	(inche	7-5/8"	-	+			_				
-		ling or Drill Pipe (ft Used (each plug)		330	-	-							
_	otume To Be Pi			87	-	_							
	ed Top of Plug			0	_	1							
	d Top of Plug (	See 1		0	4				-				
-	t (Lb/Gal.)			15.6	_	1							
		faterial (Class III)		Class A									
	ĹIS	T ALL OPEN HOLE AND/O	R PERFORATED INT	_	_	S WHERE CAS	ING WILL BE	VARIED (IT.	(mr)				
	From		To	T		From	T		To				
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L.		name of the same o											
\$25,00	d Cost to Plug	Wells											
at im po	tachments and formation is tru ssibility of fine	e penalty of law that I have that, based on my inquiry se, accurate, and complete a and imprisonment. (Ref.	personally examin- of those individual I am aware that the 40 CFR 144.32)	s immediat here are si	familiar with tely responsit	ble for obtaini	ng the inform	ration, I beli	eve that the including the	•			
		(Please type or print)		nature	1	1.1	1 20		Date Signed				
Kennel	h K. Humphre	ys, Chief Executive Offi	cer	H.	wett	H Ha	mple-e-	1.4	03/03/201	4:			

						<b>DMB No. 2040</b>	-0042 Ap	proval Expir	es 11/30/2014	65
				s Environme		on Agency				
₽E	PA	PLU	IGGING A	Washington, ND ABA		MENT PL	AN			
Name an	d Address of F	acility		T	Name and A	ddress of Owne	n/Operator			
Well 3	153, FutureGe	m 2.0, Morgan County, II			FutureGen 73 Central	Alliance Park Plaza E	ast, Jackson	ville, IL 620	550	
Lo	rate Well and C	Outline Unit on	State	de de		County		Permit	Number	
Sec	tion Plat - 640	Acres	14,000	e Location D		Morgan		_		
-		N	(minute)	promote	and the second	of HW 1.4 of	Parker 25	T	160 0	Que
	i_i_i	ا_ئ_ئ_ل	-		10000	om nearest lin				
F	<del> </del>	<del>•</del>	Surfac Locati and	on ft. fr	m (N-S)	Line of quarte	r section	72 West 00 15 4 15 15	ACTIVITY	
w =	<del> </del>			ndividual Pe krea Pennit		THOSE.	greens.	55 I 55 II		
F	<del> -</del>  - - -			tule ber of Wells	1		_8	Brine Dispos Enhanced Re Hydrocarbon SS III	covery	
- 35-	* * *	s	96000				280000000	2000		
_				Nam+		-	Well Num			and the second
		SING AND TUBING RECOR			HOLE SIZ		OD OF EMP	LACEMENT O	F CEMENT P	LUCS
SIZE	WT (LB/FT)	TO BE PUT IN WELL (FT)				E Th	e Balance M	ethod		
7-5/8	26.4	0-130	350	_	17.5"	-	e Dump Sail			
17576	20.9	E. STEW	330		10.4	many and a	e Two-Plug I her	Nethod		
	CEMENTING	TO PLUG AND ABANDON D.	ATA:	PLUG A	1 PLUG	2 PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #7
Size of h	lale or Pipe in	which Plug Will Be Placed	inche	7-5/8"						
THE REAL PROPERTY.	THE RESERVE AND ADDRESS OF THE PARTY.	oing or Orill Pipe (ft		330	4				1	
_		Used (each plug)		74	_	_	_			
	olume To Be Pi ed Top of Plug			87	_	_	_			
	d Top of Plug (	550 15000 0000 000		0	-	+	-			-
-	t. (Lb./Gal.)			15.6	-	_	_			
		Material (Class III)		Class A	O C					
	ĹIS	ST ALL OPEN HOLE AND/OR	PERFORATED II	NTERVALS A	ND INTERVA	LS WHERE CAS	SING WILL BE	VARIED (if	arry)	
	From		To			From			To	
				- 4						
L										
\$25,00	d Cost to Plug	Wells					446			
				Certific	ation					
att	tachments and formation is tru	e penalty of law that I have that, based on my inquiry ie, accurate, and complete, a and imprisonment. (Ref.	of those individu	ined and am	familiar with	ible for obtain	ng the infon	nation, I beli	eve that the	
Name ar	d Official Title	(Please type or print)	19	ignature					Date Signed	d
		eys, Chief Executive Offic		28	nett	W. 7/	undre	-16	03/03/201	
B	and the second second second second		GRACE TO THE					di	The second secon	20

θE	PA	1	PLU	United States W GGING AN	ashington,	DC 20460		AN					
Accessed to	d Address of F 154, FutureG	en 2.0, Moryan Cou	mty, IL	(1935)		Name and Address of Owner/Operator  FutureGen Alliance 73 Central Park Plaza East, Jacksonville, IL 62650							
Loc	ate Well and	Dutline Unit on		State			ounty		Permit	Number			
	tion Plat - 640			Illinois		114	Morgan						
г	1 1 1	N I I I		granteng	Location D of 50 1/4	Spiritualing .	90 1/4 of	Section 34	Township	16n Range	9w		
-	<b>┽</b> ━┝╾┽ ┽━┝╾┽ ┼━┝╾┼		_	Surface Location and		m (N/S)	m nearest line line of quarter of quarter se	section	section and	drilling unit	V3		
*	<del>                                     </del>	<b>→</b>	- -	☐ AN	lividual Per ea Permit le er of Wells		ON		SS I IS II Irine Dispos Inhanced Re Iydrocarbon ISS III	covery			
_	-	ASING AND TUBING R	reens				Lucia	_	ACEMENT O	COLUMN	ee		
8/ZE	WT (LB/FT)	TO BE PUT IN WEL	L (FT)	TO BE LEFT IN V		HOLE SIZE	☑ Th	e Balance Mo	thod	r GEMENT P	LUGS		
7-5/8	26.4	0-350	-	350		11.5"	☐ In	e Dump Bailer Method ne Two-Plug Method ther					
		11						8847.					
	CEMENTIN	G TO PLUG AND ABAN	DON DAT	ra:	PLUG #	PLUG #2	PLUG #3	PLUG #4	PLUC 45	PLUG #6	PLUG #T		
		which Plug Will Be P	laced (in	sche	7-5/8**								
-	THE RESERVE AND ADDRESS OF THE PARTY OF THE	bing or Drill Pipe (ft			330								
-	_	Used (each plug)			74						_		
	ed Top of Plug	umped (cu. ft.)			87	-	-						
	d Top of Plug	Description of the second			0	-	-	<del></del>			_		
-	t. (Lb/Gal.)	(in cagged in )			15.6	+	-						
		Material (Class III)			Class A	+	-				_		
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	From	ST ALL OPEN HOLE A	IND/OK P	To To	ERVALS A	ND INTERVAL	From	ING WILL BE	AVIOLED (IL I	To			
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\$25,00		100000											
att	achments and	e penalty of law that I that, based on my in	iquiry of	those individual	s immediat	familiar with t	le for obtaini	ng the inform	ration, I belli	eve that the			
		ue, accurate, and con e and imprisonment.			here are si	gnificant pena	ilties for suba	itting false i	nformation,	including the			

Knett H Handreys

EPA Form 7520-14 (Rev. 12-11)

Kenneth K. Humphreys, Chief Executive Officer

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decision of	d Address of F 485, FutureG	actity en 2.0, Morgan Count	ly, IL			FutureGen A	dress of Owne Alliance Park Plaza Ea	ose nave	ville, IL 626	50			
1 0.00	SSANWEAU PAU	0244340004614461		State		I	county		Permit Number				
	cate Well and o ction Plat - 640	Dutline Unit on Acres		Illinois		1.15	Morgan						
_		N	<u> </u>	granteng	paramong	escription	90 1/4 of	Section 26	Township	160 Sanne	9w		
* -		<b>⊕</b>	E .	Surface Location and Z indi- Area Rule	ft. from (II TYPE OF vidual Per vidual Per i Permit of Wells	m (N/S) Line EW) Line AUTHORIZATI mit	m nearest line. Line of quarter e of quarter se	section ction.	WELL / IS II rine Dispos: nhanced Re ydrocarbon IS III	LCTIVITY II Covery			
	-	COVE AND TURNING OF	2000 45750				Lucia	_		COLLENS	uee.		
SIZE	WT (LB/FT)	TO BE PUT IN WELL		LEFT IN W		HOLE SIZE	-1150	OD OF EMPL e Balance Me		r GEMENT P	LUGS		
13-3/8	54	0-130	130			17.5"	Th	e Dump Saile	r Method				
7-5/8	26.4	0-350	3.50			11.5"	H H70						
			_			_	_ L 0t	ter					
	CEMENTIN	G TO PLUG AND ABAND	ON DATA:		PLUG #	PLUG #2	PLUG #3	PLUG #4	PLUG #5	PLUG #6	PLUG #		
Size of h	11-57-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-7-	which Plug Will Be Pla	G OLMSV MOD		7-5/8"	1724772	1.000.10	1200	122012	1200			
		bing or Drill Pipe (ft			330								
Backs of	Cement To Be	Used (each plug)			74								
Slurry V	otuma To Be P	umped (cu. ft.)			87								
	ed Top of Plug	No. of the second second			0								
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	it. (Lb/Gal.)	Material (Class III)		-	15.6		-						
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\$25,00	ed Cost to Plug (i)	Wells						-110					
		e penalty of law that I h		y examine		familiar with t							
im	formation is tr	that, based on my inque, accurate, and comp e and imprisonment. ()	lete. I am awa	are that th									

Kenneth K. Humphreys, Chief Executive Officer

₽E	PA	PL	United States E W: UGGING AN	ashington,	DC 20460		AN					
donners .	d Address of F M1, FutureGo	actity en 2.0, Morgan County, I	L		Name and Address of Owner-Operator  Future-Gen Alliance 73 Central Park Plaza East, Jacksonville, IL 62650							
		Outline Unit on	State Illinois		1 50	ounty Iorgan		Permit	Permit Number			
500	tion Plat - 640 /	N N	protein .	Location D		proving	Section 27	Township	160 Sange	9w		
w =	1-1-1- 1-1-1- 1-1-1- 1-1-1- 1-1-1-	<b>0</b> + + + + + + + + + + + + + + + + + + +	Surface Location and    / Ind	ft. from (E TYPE OF Ividual Per la Permit	AUTHORIZATIO	ne of quarter of quarter se	ction.	WELL /	activity al covery			
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	CA	SING AND TUBING RECOR	D AFTER PLUGGIN	o		METH	OD OF EMPL	ACEMENT O	F CEMENT P	LUGS		
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	otume To Be Pi ed Top of Plug			5	-							
	d Top of Plug (	Control of the contro		0	-							
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	Lis	T ALL OPEN HOLE AND O	R PERFORATED INT	_	ND INTERVALS	WHERE CAS	ING WILL BE	VARIED (if I	iny)			
	From		Yo			From			To			
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	tachments and	e penalty of law that I have that, based on my inquiry	personally examine of those individual	s immediat	familiar with the	e for obtaining	ng the inform	ation, I beli	eve that the			
im		ie, accurate, and complete a and imprisonment. (Ref.			and the second	3.04.107.4400	manage investor	in serious desires	manage and			
po	ssibility of fine		40 CFR 144.32)	nature	paractions position		that is a second		Date Signed			

≎EPA	Unite		nvironment shington, D	al Protection C 20460	Agency	2000						
VEIX	PLUGGIN	IG ANI	DABA	ANDONMENT PLAN								
Name and Address of Facility			Na	Name and Address of Owner Operator								
Well TM2, FutureGen 2.0, Morgan C	ounty, IL			utureGen A 3 Central P	lliance ark Plaza East, Jacksonville, IL 62650							
Locate Well and Outline Unit on		State	3911		ounty	Number						
Section Plat - 640 Acres		Illinois			Morgan							
	00-00 PV	gradient	ocation De	Contractor Contractor	present	and the same		Geograph II I I I I I	provinces.			
	: I	8W 1/4 of 5W 1/4 of 5W 1/4 of 8W 1/4 of Section 31 Township 16ft Range 9W										
	†- †-	Locate well in two directions from nearest lines of quarter section and drilling unit Surface Location ft. from (N:S) Line of quarter section and ft. from (E:W) Line of quarter section.  TYPE OF AUTHORIZATION WELL ACTIVITY										
⊕ s	/ Individual Permit Area Permit Rule Number of Wells			CLASS I CLASS II Brine Disposal Enhanced Reco Hydrocarbon St CLASS III			i overy					
CASING AND TUBIN	D RECORD AFTER	PLUGGING			METH	OD OF EMPL	ACEMENT O	F CEMENT P	LUGS			
SIZE WT (LB:FT) TO BE PUT IN W (7-5/8) 26.4 (0-20)	ELL (FT) TO BE	LEFT IN WE		HOLE SIZE	The Balance Method The Dump Bailer Method The Two-Plug Method Other							
CEMENTING TO PLUG AND AB	ANDON DATA:		PLUG #1	PLUG #2	PLUG #3	PLUG #4	PLUC #5	PLUG #6	PLUG #			
Size of Hole or Pipe in which Plug Will B	e Placed (inche		7-5/8"									
Depth to Bottom of Tubing or Drill Pipe (	n		20					1				
Sacks of Cement To Be Used (each plug)			4									
Slurry Volume To Be Pumped (cu. ft.)			5	_					-			
Calculated Top of Plug (ft.) Measured Top of Plug (if tagged ft.)		-	0	_		-						
Slurry Wt. (Lb/Cal.)		-	15.6	-								
Type Cement or Other Material (Class III)			Class A									
LIST ALL OPEN HOLI	E AND/OR PERFOR	ATED INTE	-	INTERVALS	WHERE CAS	ING WILL BE	VARIED (if a	mr)				
From	To				From	T		To				
			3 (									
Estimated Cost to Plug Wells \$2,000												
			Certifical	tion								
I certify under the penalty of law th attachments and that, based on my information is true, accurate, and o	inquiry of those is	ndividuals	immediate	ly responsibl	e for obtaini	ng the inform	ration, I bell	eve that the				

Signature Kushl. H. Hangdwags

EPA Form 7520-14 (Rev. 12-11)

Name and Official Title (Please type or print)

Kenneth K. Humphreys, Chief Executive Officer

Date Signed

&EPA	02704	United States I W	Environmen ashington, i		Agency	2000					
~=:/\	PLU	IGGING AN	ID ABA	NDONM	ENT PL	AN					
Name and Address of Facility Well TM3, FutureGen 2.0,	Morgan County, IL		1 5	FutureGen A	Iliance	ress of Owner/Operator Iliance ark Plaza East, Jacksonville, IL 62650					
To the volument and only with another	SUMMERS.	State	-11	T <sub>C</sub>	ounty	12.1-12.0-2-1	Permit Number				
Locate Well and Outline Section Plat - 640 Acres	Unit on	Illinois			Aorgan		1.49000				
a section of the same matter		Surface	Location De	scription							
T T		ne. 1/4	of 50 1/4	of ne 1/4 of	HW 1/4 of	Section 25	Township	16n Range	9w		
SIZE WT (LB/FT) TO B (7-5/8) 26.4 (0-20)	Surface Location and  I ind Are Rui Numbe	Surface Location R. frm (N-S) Land R. from (E/W) Line TYPE OF AUTHORIZATION / Individual Permit Area Permit Rule Number of Wells 1 Lease Name			CLASS I CLASS II CLASS II Enhanced Recow Hydrocarbon Sto CLASS III Well Number METHOD OF EMPLACEMENT OF CE			VITY iry rage			
					☑ on	ner					
		1									
	UG AND ABANDON DA	1707	PLUG #1	PLUG #2	PLUG #3	PLUG #4	PLUC 45	PLUG #6	PLUG #		
Size of Hole or Pipe in which I		inche	7-5/8"	-	-			_			
Depth to Bottom of Tubing or Sacks of Cement To Be Used (	CONTRACTOR OF THE PARTY OF THE		20	+							
Slurry Volume To Be Pumped	The state of the s		5	1							
Calculated Top of Plug (ft.)			0	1							
Measured Top of Plug (if tagge	d ft.)		0								
Slurry Wt. (Lb./Gal.)			15.6								
Type Cement or Other Material	(Class III)		Class A				11		1		
LIST ALL	OPEN HOLE AND/OR	PERFORATED INT	ERVALS AN	D INTERVALS	WHERE CAS	ING WILL BE	VARIED (If I	iny)			
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Estimated Cost to Plug Wells	_1										
\$2,000											
			Certifica	ition							
I certify under the penal attachments and that, b information is true, accu	ased on my inquiry o	f those individual	s immediate	ely responsibl	e for obtaini	ng the inform	ration, I beli	eve that the			

Signature Knoth H Hangdrays

EPA Form 7520-14 (Rev. 12-11)

Name and Official Title (Please type or print)

Kenneth K. Humphreys, Chief Executive Officer

Date Signed

		OMB No. 2040-0042	Approval Expires 11/30/2014
	United States Environmental Prote		
<b>≎EPA</b>	Washington, DC 2046	0	
WEI /	PLUGGING AND ARANDO	NMENT PLAN	

₽E	PA	PL	UGGIN			NDON	MENT PL	AN					
Name ar	nd Address of F	acility			1	lame and Ad	idress of Owne	r/Operator					
-		m 2.0, Morgan County,	п			FutureGen			rille, IL 626	550			
	cate Well and C			State Illinoi s			County		Permit	Number			
		_		Surface L	ocation D	escription			***				
	111	1 1 1 1 1		8W 1/4 o	se 1.4	of EW 1/4	of 90 1/4 of	Section 34	Township	16n Range	9w		
-	<del>  -   -   -   -   -   -   -   -   -   -</del>	- <b>-</b>		Surface Location and1	ft. from (E	n (N/S)	oin nearest lin	section	2774000743525		8		
*	<del> </del>		E	Indiv	ridual Per Pennit		TION:	ON WELL ACTIVITY  CLASS I  CLASS II  Brine Disposal  Enhanced Recovery  Hydrocarben Storage  CLASS III					
		5		Lease Nan	ne			Well Num	ber				
_	CA	SING AND TUBING RECO	PO AFTER P		_		METH	OD OF ENE	ACEMENT O	F CEMENT P	ues		
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Size of I	11.57.7733333	which Plug Will Be Place	m2V m00	_	7-5/8"	1			1000	1000			
	_	sing or Drill Pipe (ft			20								
Backs o	f Cement To Be	Used (each plug)			4								
Slurry V	otume To Be Pi	umped (cu. ft.)			5								
Calculat	ed Top of Plug	(nt.)			0								
Measure	d Top of Plug (	if tagged ft.)			0								
	/t. (Lb/Gal.)				15.6								
Type Ce		daterial (Class III)			Class A								
	-	ST ALL OPEN HOLE AND		TED INTE	RVALS AN	ID INTERVA		ING WILL BE	VARIED (If				
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at in	tachments and formation is tru	e penalty of law that I hav that, based on my inquin se, accurate, and complet a and imprisonment. (Ref	of those in	examined dividuals re that the	immediat	familiar with ely respons	ible for obtaini	ng the inform	ration, I bell	eve that the	·		
Name at	nd Official Title	(Please type or print)		Sign	ature					Date Signed	15		
			ficer			4 -	Hun	Lucy		03/03/2014			
	eth K. Humphreys, Chief Executive Officer					1				The section of the section is	5		

DMB No. 2040-0042 Approval Expires 11/30/2014 United States Environmental Protection Agency Washington, DC 20460 PLUGGING AND ABANDONMENT PLAN Name and Address of Facility Name and Address of Owner/Operator Well MS5, FutureGen 2.0, Morgan County, IL FutureGen Alliance 73 Central Park Plaza East, Jacksonville, IL 62650 Permit Number Locate Well and Outline Unit on Illinois Morgan Section Plat - 640 Acres Surface Location Description 8W 1/4 of 8W 1/4 of 8W 1/4 of 90 1/4 of Section 26 Township 168 Range 9W Locate well in two directions from nearest lines of quarter section and drilling unit Location ft. frm (N.S) Line of quarter section ft. from (E/W) Line of quarter section. TYPE OF AUTHORIZATION WELL ACTIVITY CLASS I / Individual Permit Area Pennit CLASS II Brine Disposal Rule Enhanced Recovery Number of Wells 1 Hydrocarbon Storage CLASS III Lease Name Well Number METHOD OF EMPLACEMENT OF CEMENT PLUGS CASING AND TUBING RECORD AFTER PLUGGING WT (LB/FT) TO BE PUT IN WELL (FT) TO BE LEFT IN WELL (FT). HOLE SIZE The Balance Method 11.5" 7-5/8 26.4 The Dump Sailer Method The Two-Plug Method ✓ Other CEMENTING TO PLUG AND ABANDON DATA: PLUG #1 PLUG #2 PLUG #3 PLUG #4 PLUG #5 PLUG #6 PLUG #7 Size of Hole or Pipe in which Plug Will Be Placed (inche Depth to Bottom of Tubing or Drill Pipe (ft Sacks of Cement To Be Used (each plug) 4 Slurry Volume To Be Pumped (cu. ft.) Calculated Top of Plug (ft.) Measured Top of Plug (if tagged ft.) Slurry Wt. (Lb./Cal.) Type Cement or Other Material (Class III) LIST ALL OPEN HOLE AND/OR PERFORATED INTERVALS AND INTERVALS WHERE CASING WILL BE VARIED (if any) From Estimated Cost to Plug Wells \$2,000 Certification I certify under the penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the

Signature

Kutt H Hundrage

EPA Form 7520-14 (Rev. 12-11)

Name and Official Title (Please type or print)

Kenneth K. Humphreys, Chief Executive Officer

possibility of fine and imprisonment. (Ref. 40 CFR 144.32)

Date Signed